EXHIBIT 1

Expert Report of Dr. Tobias Dewhurst

Wild Fish Conservancy v. Cooke Aquaculture Pacific, LLC

Case No. 2:17-cv-01708-JCC

June 5, 2019

Toby Dewhurst

Dr. Tobias Dewhurst
Hydrodynamics Engineer
Maine Marine Composites

This report replaces the Expert Report of Dr. Tobias Dewhurst submitted in this matter that was dated April 10, 2019.

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1 Summary of Opinions

Based on the assessments described in this report, the opinions of the author are as follows:

- Cooke did not inspect all portions of mooring systems on an annual basis as required by section S6.F of its National Pollution Discharge Elimination System (NPDES) permits and as stipulated by the net pen manufacturers' manuals provided by Cooke. Specifically, Cooke did not annually inspect anchoring components that were below a depth of 100 feet.
- Cooke's NPDES permits required the "Identification and implementation of technology that will minimize fish escapements." However, Cooke failed to identify and implement certain critical net pen technologies necessary to prevent escapes. Specifically, conditions at each of its eight sites exceeded the maximum rated conditions specified by the net pen manufacturer. Based on Cooke's documentation that I have reviewed to date, these issues persist at many of the remaining net pen sites. Thus, the remaining net pen systems may be at risk of partial or catastrophic failure during instances of extreme environmental loading, which could result in fish escapement.
- The apparent lack of rigorous analyses of maximum current speed for each site introduced a risk of structural failure during instances of maximum current speed. This risk is a particular concern for those net pens whose configurations exceed the maximum rated conditions specified by the net pen manufacturer.
- As a result of excessive loads on the net pen system created by:
    - currents and net sizes exceeding those specified by the net pen manufacturer,
    - biofouling levels potentially exceeding design values, and
    - mooring system installations that deviate from manufacturer recommendations and were not approved by a marine engineer,

  pens and cages operated by Cooke were at risk of complete failure. One pen, Cypress Site 2, did experience a catastrophic failure.
- While achieving certainty with regard to the cause of the Cypress Site 2 failure may not have been possible, Cooke's failure to even attempt such an analysis deprives Cooke of critical information and data that it could apply to its other operations in order to reduce the risk of a similar collapse in the future. This is particularly concerning because, as with Cypress Site 2, certain remaining sites appear to be operating in conditions that exceed those specified by the net pen system manufacturers.
- Cooke avoided costs in failing to inspect all portions of mooring systems on an annual basis as required by it permits. Cooke also avoided costs in failing to identify and implement technology to minimize fish escapes.

2 Introduction

My name is Tobias Dewhurst and my work address is 2 Portland Fish Pier, Portland, Maine 04101. I have been retained as an expert familiar with the engineering of marine aquaculture structures by the law firm of Kampmeier and Knutsen to provide this report on behalf of Wild Fish

Conservancy, in the case of *Wild Fish Conservancy v. Cooke Aquaculture Pacific, LLC*, ("CAP" and "Cooke") no. 2:17–cv–01708. I expect to testify at trial regarding the subject matters set forth in this Report, if asked about these matters by the Court or by the parties' attorneys. I reserve the right to update my Report as I am able to review produced documents and as additional data become available, and as necessary if and when Cooke provides any reports from its experts. I have previously provided a declaration in this matter (ECF No. 52-2), and I incorporate that declaration herein by reference.

I am being compensated at the rate of $175/hour for my work in this matter. I have never testified as an expert at trial or by deposition in another case.

2.1 Purpose and Scope

The purpose of this report is to:

- provide opinions on whether the catastrophic failure of Cooke's Cypress 2 net pen in August 2017 is attributable in part to Cooke's failure to identify and implement appropriate technology and best/appropriate industry standards and practices;
- provide opinions on whether Cooke's operations and maintenance of its eight net pens in Puget Sound conformed to and complied with its NPDES permit requirements, including its Pollution Prevention Plan and it Fish Release Prevention and Monitoring Plan; and
- identify actions/technology (structural, engineering, best practices, or otherwise) Cooke could have implemented, or could implement in the future, to comply with its permits and provide cost estimates for those actions/technology.

2.2 Qualifications and Materials Reviewed

The author has prepared this report in the capacity of an expert familiar with the engineering of marine aquaculture structures and the technologies and practices needed to maintain such structures so as to prevent partial or catastrophic failures and other causes of pollution, including fish releases. In preparing the report, other MMC staff, including Richard Akers, PE, assisted the author by helping to identify, organize, and review relevant records, including data related to the cost estimates provided. The opinions expressed in the report are solely the author's own and are based on the author's expertise in the field of marine engineering. The author's qualifications are presented in his Curriculum Vitae at Appendix 4.

The author reviewed plans, reports, industry standards, and industry best practices in the preparation of this report. The materials reviewed do not represent an exhaustive investigation of Cooke Aquaculture Pacific's practices in the State of Washington. In addition to the author's familiarity with relevant literature, a list of records and documents the author considered in preparing this report is provided at Appendix 7. Appendix 7 contains the facts and data on which the author considered in forming his opinions. The author reserves the right to update Appendix 7 as new facts and data become available, either through discovery or otherwise.

3 Permits, Standards, and Best Practices

3.1 Facts

3.1.1 NPDES Permits

Cooke's aquaculture operations in Puget Sound are permitted under the National Pollutant Discharge Elimination System (NPDES).[1] These permits include requirements that the permittee develop, among other items:

- a Pollution Prevention Plan, and
- a Fish Release Prevention and Monitoring Plan.

These plans were updated at various intervals throughout the duration of the permits. A chronology of the applicable Pollution Prevention Plans is given in Table 1. A chronology of the applicable Fish Escape Prevention Plans is given in Table 2.

Table 1. Chronology of Pollution Prevention Plans, according to Cooke[2]

Name	Dates	Bates Number
American Gold Seafoods - NPDES Pollution Prevention Plan, Updated: January 2010	January 2010 to November 2011	To be produced.
American Gold Seafoods - NPDES Pollution Prevention Plan, Updated: November 2011	November 2011 to April 2012	To be produced.
American Gold Seafoods - NPDES Pollution Prevention Plan, Updated: April 2012	April 2012 to January 2015	COOKE_CWA_00027221 to COOKE_CWA_00027227
American Gold Seafoods - NPDES Pollution Prevention Plan, Updated: January 2015	January 2015 to April 2017	COOKE_CWA_00027228 to COOKE_CWA_00027231
Cooke Aquaculture Pacific – Pollution Prevention Plan, Updated: April 2017	April 2017 to October 2017	COOKE_CWA_00027232 to COOKE_CWA_00027234
Cooke Aquaculture Pacific – Pollution Prevention Plan, Updated: October 2017	October 2017 - Present	COOKE_CWA_00027240 – 00027243, 00027249 - 00027250

[1] COOKE_CWA_00019607.pdf
[2] 2018.08.31 - Cooke Answers to WFC 2nd Disc Reqs.pdf

Table 2. Chronology of Fish Escape Prevention Plans and Fish Escape Reporting and Response Plans, according to Cooke[3]

Name	Dates	Bates Number
Icicle Acquisition Subsidiary, LLC DBA American Gold Seafoods - Fish Escape Prevention Plans, Updated June 2009 Icicle Acquisition Subsidiary, LLC DBA American Gold Seafoods - Fish Escape Reporting and Response Plan, Updated June 2009	June 2009 to August 2012	COOKE_CWA_00027264 to 00027278
Icicle Acquisition Subsidiary, LLC DBA American Gold Seafoods - Fish Escape Prevention Plans, Reviewed August 2012 Icicle Acquisition Subsidiary, LLC DBA American Gold Seafoods - Fish Escape Reporting and Response Plan, Reviewed August 2012	August 2012 to June 2014	To be produced.
2014 Icicle Acquisition Subsidiary, LLC DBA American Gold Seafoods - Fish Escape Prevention Plans, Updated June 2014 Icicle Acquisition Subsidiary, LLC DBA American Gold Seafoods- 2014 Fish Escape Reporting and Response Plan - Updated June 2014	June 2014 to January 2017	COOKE_CWA_00027288 to 00027325
2017 Cooke Aquaculture Pacific, LLC - Fish Escape Prevention Plan, Updated January 2017	January 2017 - Present	COOKE_CWA_00027279 to 00027287

In addition to the Plans listed in Table 2, Cooke submitted an updated Fish Escape Prevention Plan in October of 2018[4].

3.1.2 Best Aquaculture Practices

Cooke's salmon operations in the state of Washington are "certified using Best Aquaculture Practices."[5] This refers to an industry standard created and maintained by the Global Aquaculture Alliance (GAA), Portsmouth, NH (formerly St. Louis, MO), called:

Aquaculture Facility Certification
Salmon Farms
Best Aquaculture Practices Certification Standards, Guidelines

GAA released versions of this standard as described in Table 9. According to these Best Aquaculture Practices (BAP), either Version 2, Rev. 2 or Issue 2, Revision 3 applied at the time

[3] 2018.08.31 - Cooke Answers to WFC 2nd Disc Reqs.pdf
[4] COOKE_CWA_00147341
[5] 30(b)(6) Cooke Aquaculture Pacific, LLC - Parsons Vol 2 eFFICIENT Transcript Package.pdf. p293.

of the Cypress Site 2 pen collapse in August, 2017. Key sections of the *Best Aquaculture Practices for Salmon – Control of Escapes* are quoted in Appendix 1.

3.1.2.1 Washington Fish Growers Association (WFGA) Code of Conduct

As part of Cooke's Best Aquaculture Practices certification, an *Aquaculture Facility Certification* Auditor Checklist[6] was created for "Icicle Acquisition Subsidiary, LLC dba American Gold Seafoods, Cypress Island Site." In this audit document there is a checklist heading entitled "1.6 Where applicable current documents shall be available to show compliance with the farm's own industry codes of practice." The auditor entered the following response to this heading:

> "Icicle Seafoods has their own Code of Practice, latest revision March 2015. A letter from Dan Swecker, president of the Washington Fish Growers Association (WFGA) states that American Gold Seafoods (Icicle) complies with WFGA Code of Conduct."

The Washington Fish Growers Association (WFGA) publishes a Code of Conduct[7] for Saltwater Salmon Net-Pen Operations, last updated in fall, 2002. This document states:

"Containment of Fish Stocks

- *By law, finfish farmers in Washington must have a Washington Department of Fish and Wildlife-approved escape prevention plan that includes:*
    - *Procedures to minimize escapes when rearing vessels, pens or cages are moved, repaired or manipulated, or during stocking or harvesting operations."*

3.1.3 Norwegian Standard 9415.E:2009

Standards Norway (Standard Norge) has published NS 9415: "Marine fish farms–Requirements for site survey, risk analyses, design, dimensioning, production, installation and operation". The stated purpose of NS 9415 is to "reduce the risk of escape as a result of technical failure and wrong use of marine fish farms." NS 9415 is referenced by BAP and is an internationally accepted industry standard. Key text from this standard is quoted in Appendix 2.

3.2 Analysis and Discussion

In this report, Cooke's various Pollution Prevention Plans and Fish Escape Prevention Plans were evaluated for their compliance with the requirements of the NPDES permits. In addition, the author referred to the Best Practices and Standards listed in Section 3.1 of this report for clarification.

Where sufficient information was available, Cooke's actions were evaluated to determine whether its implementation of technology, operations, and maintenance of its net pens in Puget Sound conform to and comply with its NPDES Permits and Plans.

[6] COOKE_CWA_00019992, *Aquaculture Facility Certification* Auditor Checklist, Part 2 Salmon Farm Standard, Version 2, May 2015, p. 6.
[7] WFGA Code of Conduct (http://www.wfga.net/conduct.php)

4 Permit Requirements: S6 Pollution Prevention Plan

4.1 NPDES Permit Requirements for the Pollution Prevention Plan

4.1.1 Facts

Section S6 of the NPDES Permits enumerates the requirements for the Pollution Prevention Plan. Specific requirements examined in this report were that the Permittee must address the following in the plan:

- S6.B "How net cleaning will be conducted in order to minimize the discharge of accumulated solids and attached marine growth."

- S6.F "The Permittee shall routinely, at least weekly, conduct visual inspections of exposed surface lines, shackles, and mooring points. Any defective components are to be repaired or replaced promptly. At least once per year, conduct an inspection of the main cage structure and anchoring components above and below the water line. Document any problems and maintain all components to prevent failure that could lead to fish escapements."

  "The Permittee shall conduct inspections after any major storm event or physical accident involving the pen structures or moorings, and make any repairs necessary."

S6.B reflects Permit requirements S5.A.9 and S5.A.10:

> S5.A.9 "The Permittee must dispose of accumulated solids and attached marine growth contained within or on the net pen in a manner which prevents to the maximum extent practical these materials from entering or reentering waters of the state."
>
> S5.A.10 "The Permittee must not discharge accumulated solids and marine growth removed from the finfish rearing units into waters of the state without prior treatment."

4.2 S6.B - Net Cleaning and Discharge of Marine Growth

4.2.1 Facts

4.2.1.1 <u>Cooke's Permit Plan</u>

The Pollution Prevention Plan (PPP) submitted as Attachment B of the NPDES Permit Renewal Application Packages submitted in 2012 for all eight sites states that:

- Nets are typically pulled to the surface and changed annually.
- Fouled nets are shipped to a land based net cleaning and net repair facility for "…washing, capturing and disposing of waste materials from the cleaning process.
- Nets are dipped in a water-based copper antifouling paint at the above facility.

This PPP makes no mention of in-water net washing. NPDES permit states that no antifouling coatings are permitted. However, Section 3.8 of the PPP states that the "facilities have approval from the Department of Ecology to allow for use of the Flexgard XI net-coating product."

Starting with the January 2015 update, Pollution Prevention Plans provided by Cooke reference in-situ rinsing of nets with pressurized seawater.

Neither the NPDES Permit nor any of the Pollution Prevention Plans specify a maximum allowable level of biofouling. However, NS 9415 specifies that farms be designed to survive up to 50% biofouling of the nets. In this standard, 50% biofouling is applied as a 50% increase in the solidity of the net. The solidity of the net is defined as its actual projected area divided by its outline area. Similarly, the manual for the Procean Ocean Catamaran Platform used at the Fort Ward, Orchard Rocks (Saltwater IV), and Clam Bay sites specifies a maximum biofouling of 50%.

4.2.1.2 Implementation by Cooke

Reviewing the daily logs for the salmon farms, there is inconsistent mention of removing nets for cleaning. In most cases the log entries refer to mechanical cleaning using an MPI, Stingray, Idema or AutoBoss in situ cleaner. The NETWASHING PRACTICES section of Attachment B does not mention in situ cleaning. There are no records of debris disposal from the in situ cleaning systems.

There were very few references to removing nets and cleaning them by raising them to the surface per the AGS Pollution Prevention Plans.

According to the "Netwashing Practices" section in Attachment B of the NPDES PERMIT RENEWAL APPLICATION PACKAGES for all eight sites, Cooke planned to pull the fish containment nets to the surface once per year on average. As cultured fish stocks typically take 18 to 22 months in seawater to reach harvest sizes, the containment nets may be changed out 2 times during this growing period.[8]

Using the logs and other material supplied by Cooke, it is very difficult to determine whether the actual net-washing practices met or exceeded their plans. No records were found describing the effectiveness of the Stingray, MPI, Idema and AutoBoss in-situ cleaning systems.

According to the "FISH FARM SURVEY REPORT" describing the Clam Bay site, dated June 15, 2011, written by Aquaculture Risk (Management) Ltd and Sunderland Marine, for American Gold, diving by site staff for "Equipment inspection" happens "3 x weekly" in both summer and winter. Further, "Divers to report level of fouling on nets according to an established score system."

A similar survey dated July 12, 2016 says that diving at the Clam Bay site is performed "When required (see Reasons)," and for reasons lists "Mort retrieval," Suspected damage to cage/net/moorings," and "Cage/net/mooring inspection."

The planned number and frequency of dives dropped off significantly between the 2011 survey and the 2016 survey.

[8] Eight references including COOKE_CWA_00054113.pdf.

4.2.2 Analysis and Discussion

Based on the logs and net cleaning and repair records, it is not possible to determine whether the nets at each site were kept free of biofouling, or even to determine the maximum percentage of fouling. It is noted in section 6.2.1 of this report that Cooke employees described significant biofouling at Cypress Site 2 during the summer of 2017.

It is noted that Cooke's operations and Pollution Prevention Plans—starting in January 2015—include the use of in-situ net washing. This is common practice in many aquaculture industries and geographical locations. However, it is noted that in-situ washing may not be consistent with the Permit's requirements that "The Permittee must dispose of accumulated solids and attached marine growth contained within or on the net pen in a manner which prevents to the maximum extent practical these materials from entering or reentering waters of the state" and "The Permittee must not discharge accumulated solids and marine growth removed from the finfish rearing units into waters of the state without prior treatment."

4.3 S6.F - Inspections and Maintenance

4.3.1 Facts

4.3.1.1 Cooke's Permit Plan

Regarding the inspection, repair, and replacement of net pen structures, the Pollution Prevention Plans from 2012 up to, but not including October 2017 state that:

1. "The Site Managers and site personnel are to routinely inspect exposed mooring components for signs of excessive wear. Any defective components are to be replaced promptly", and
2. "Below water mooring components are to be inspected and/or replaced periodically in order to maintain them in the best condition practical."

In the October 2017 update of the PPP, the plan stipulates "Weekly Visual Inspections of Exposed Surface Lines, Shackles and Mooring Points." It also stipulates "Annual Inspections of Below Water Mooring Components."

Cooke's sites in Puget Sound employed at least three different types of net pens:

- Marine Construction AS– SystemFarm
- Wavemaster Steel Cage
- Procean AS–Ocean Catamaran

The net pen system manufacturers specify the inspection requirements for their systems. Manufacturer specifications for the Marine Construction AS SystemFarm[9], the Procean AS–Ocean Catamaran[10], and the AKVA Group's Wavemaster EX-1[11] were reviewed.

The Marine Construction AS SystemFarm[12] manual specifies monthly and annual inspections. Procean AS–Ocean Catamaran manual specifies weekly, monthly, and annual inspections. For both systems, the annual inspections include items above and beyond those included in the weekly or monthly inspections. For example, the Procean AS–Ocean Catamaran annual inspection requirements include the following:

> *Once* a *year* a *thorough inspection and disinfection of the system should be carried out. If possible this should be carried out during summer months to allow* a *complete and thorough inspection of all underwater components to be checked and repaired if necessary.*
> • *Check all anchor lines for wear and tear*
> • *Check all anchor line connections and hardware*
> • *Check all anchors and anchor points*
> • *Check all can buoys and connections to* [sic]
> • *Check Predator net for wear and tear and its connection to the pred grid*
> • *…*
> • *Visually inspect all weld connections at outer beam and pontoon and main bridge and pontoon intersections.*
> • *Bolts for walkway gratings on pontoons and main walkways should be re-torqued*
> • *Check all plumbing and electrical systems*
>
> *Submerged parts of the anchoring system.*
> *Submerged parts of the anchoring system must be checked, however if the depth of these parts are to* [sic] *great for* a *diver to inspect, then it is possible to deploy an ROV (remote controlled* [sic] *operated underwater vehicle) equipped with video to perform this task. It will be necessary to stress test the lines and anchors if they are found to be slack or damaged to ensure their breaking strength and tension is sufficient. Section 3. 11*
>
> *Steel Construction*
> *Welded areas must be checked for possible cracking. Should any cracking be found then the whole system should be inspected with* a *non-destructive method preformed* [sic] *by an expert. Procean Systems Ltd. should be notified before any testing or repairs are to be carried out. The following must be checked and replaced if found necessary*
> • *Hinge bushing and bolts; maximum reduction in bushing wall before replacement is 2mm*
> • *Female hinge is to be repaired if there is an increase in hole diameter of more than 0.6mm*
> • *Shackles shall be replaced if* a *maximum reduction in metal thickness has reached 2mm*
> • *Worn out thimbles are to be replaced*
> • *All lines should be inspected for chaffing and wear. All worn or chaffed lines are to be replaced according to the anchoring plan and list of materials. Short lengths (up to 10 meters) above the water line may be replaced individually. If chaffing or wear occurs on longer lengths than 10 meters the whole line must be replaced and re-tensioned.*

[9] 8 20150310161238332.pdf
[10] COOKE_CWA_00026357.pdf
[11] COOKE_CWA_00287357-COOKE_CWA_00287401
[12] 8 20150310161238332.pdf

• All buoys and connections to should be inspected and repaired or replaced if damaged. Contact Procean Systems Ltd. Before any repairs or changes are to be implemented to the anchoring plan.

The Marine Construction AS SystemFarm manual[13] includes the following items in the annual inspection requirements:

A. Mooring fittings
B. Chain
C. Shackle
D. Heart [Unknown definition. Possibly thimble.]
E. Rope
F. Eyelet on weight [anchor]
G. Weight [anchor], type and dimension
H. Depth
I. Distance from farm outskirts
J. Seabed condition

4.3.1.2 Implementation by Cooke

Based on documents provided by Cooke and reviewed by author to date, there were no comprehensive or thorough annual inspections being conducted at Cooke's net pens that were consistent with manufacturers' specifications. During Cooke's February 28 and March 1, 2019 deposition, Cooke[14] did not identify comprehensive annual inspection reports for any years prior to 2018, but rather pointed to ongoing, regular inspection practices at Cooke. Such practices fall within the manufacturers' specifications for more frequent (weekly or monthly) but less comprehensive inspections. Per the net pen manufacturers' specifications, they do not take the place of annual inspections required by NPDES permit section S6.F.

Mooring system diagrams and inspection reports were examined by the author. The most organized record of mooring inspections identified by the author was found in mooring diagrams provided by Cooke in the form of Excel workbooks.

These documents include mooring information and, in some cases, inspection records. Each workbook was examined and the intervals were calculated between the date the author listed as "Last Updated" and the most recent recorded inspection (When no "Last Updated" date was shown, the most recent date in the workbook was taken to be the effective date of the workbook.). These workbooks did not generally define whether an inspection included all the mooring components down to the anchor.

According to this documentation provided by Cooke, Cooke did not inspect mooring components on an annual basis. Several examples are provided below.

[13] 8 20150310161238332.pdf
[14] The author understands that Mr. Parsons was deposed on May 24, 2019. The author reserves the right to modify this report after receiving the transcript of that deposition.

As of July 1, 2016, the "Last Inspection Date" listed for Cypress Site 1 mooring lines were as follows[15]: Anchors 1-6: January, 2014. Anchors 7-13: November, 2013. Anchors 14-22: October 2012. The components listed as being inspected in this case are "Surface hardware", "Surface Chain", "Mooring line", "Anchor Chain", and "Anchor Condition". In this case, certain anchor lines had not been inspected for three years and nine months.

As of July 1, 2016, the "Last Inspection Date" listed for Cypress Site 2 mooring lines were as follows[16]: Anchors 1-6: January, 2014. Anchors 7-13: November, 2013. Anchors 14-22: October 2012. The components listed as being inspected in this case are "Surface hardware", "Surface Chain", "Mooring line", "Anchor Chain", and "Anchor Condition". In this case, certain anchor lines had not been inspected for three years and nine months.

As of November 2017, the "Last Inspection Date" listed for Cypress Site 3 mooring lines corresponding to anchors 14-22 were October 2012. (It is noted that below water components were to be checked 11/12/2017). The components listed as being inspected in this case are "Surface hardware", "Surface Chain", "Mooring line", "Anchor Chain", and "Anchor Condition". In this case, anchor lines 14-22 had not been inspected for five years and one month.

4.3.2 Analysis and Discussion

4.3.2.1 The Need for Mooring Inspections

Mooring components are subject to corrosion, wear, fatigue, abrasion, and accidental damage. When chain contacts the seabed, sediments can be abrasive and erode the chain. For example, USCG Aid to Navigation Buoys are moored with chain connected to a heavy anchor. The USCG typically replaces the chain section near the touchdown point every one to three years due to loss of material from abrasion.[17] Furthermore, since the anchor should remain fixed while the chain moves, the connection between the bottom chain and the anchor can experience wear. For these reasons, the manufacturer of Cooke's Marine Construction AS SystemFarm[18] and Procean AS–Ocean Catamaran[19] cage systems specify annual inspections of all mooring components. The Procean AS–Ocean Catamaran manual specifically addresses the need to inspect even anchors that are deeper than 100 feet.

At several of Cooke's sites, inspection dives in 2017 showed that a number of anchors were inadequately embedded in the seafloor.[20,21] ROV inspections at the Hope Island site showed that

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[15] COOKE_CWA_00018363-Site 1.xlsx
[16] COOKE_CWA_00018363-Site 2.xlsx
[17] Akers, R. Fatigue Design Methodologies Applicable to Complex Fixed and Floating offshore Wind Turbines, TAP-758, Bureau of Safety and Environmental Enforcement, p. 68. Contract E13PC00019, 2015. https://www.bsee.gov/sites/bsee.gov/files/tap-technical-assessment-program//758aa.pdf, downloaded 3/26/2019.
[18] 8 20150310161238332.pdf
[19] COOKE_CWA_00026357.pdf
[20] 2018 Mott MacDonald DW Site 3 Report.pdf, p. 26 of pdf file.
[21] 2018 Mott MacDonald DW Site 1 Report.pdf, p. 25 of pdf file.

two anchors were not embedded, or only partially embedded,[22] and inspections at the Fort Ward site showed that one anchor was not embedded, sitting on the seafloor.[23] These lines will not share loads proportionately with the other lines during instances of maximum current loading, and could result in progressive mooring failures. After drag embedment anchors for a fish farm are installed, they must either be inspected or proof-tested, pulling on the anchor horizontally until the anchor embeds and provides sufficient resistance to show that it is installed properly. Without proof-testing, the only way to detect this installation problem is through at least one visual inspection of the anchor by a deep water diver or by an ROV.

During large storms and/or high currents, a fish farm can exert extreme forces on the mooring components, possibly causing anchors to break free and be dragged across the seafloor. Ideally the anchor will re-embed, but this is not guaranteed. On August 3, 2016, workers on one of the Port Angeles farms noted that the "farm dragged anchors."[24] Following that incident the daily log for the site noted "anchors set,"[25] followed by "N end loose,"[26] "anchors pulling loose,"[27] "anchors loose,"[28] and "anchors keep pulling."[29] As with initial installation, the only ways to confirm that the anchors are set properly is through a proof test or a visual inspection by a diver or an ROV.

4.3.2.2 Compliance

Based on the records provided by Cooke related to the installation and inspection of their mooring components, it appears that Cooke did not inspect all underwater mooring components annually, as required by the NPDES permits.

Deposition testimony by Mr. James Parsons[30] indicated that sections of mooring lines deeper than 100 feet were assumed to be adequate if no problems were observed in the sections within 100 feet of the surface. The position of the anchor can be inferred from observations of the surface buoy and of line tension. However, for reasons described above (section 4.3.2.1), these observations do not indicate whether the chain on the seafloor has been excessively abraded or whether the anchor is fully embedded. Furthermore, the *ad hoc* inspections implied by Mr. Parsons do not reflect the rigorous inspections mandated by the manufacturers. For example, the manufacturers' specifications specifically require annual inspections all the way down to the anchor. In the case of the Procean systems, inspections down to the anchor are explicitly described even for anchors deeper than 100 feet. Thus, the methods described by Cooke do not constitute an inspection of all mooring components as required by the NPDES permits (section S6.F).

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[22] 2018 Mott MacDonald Hope Island Report.pdf, letter from Daniel G. Stromberg at Collins Engineers, Inc., to Mott MacDonald, "Underwater Inspection of the Hope Island," p. 2.
[23] 2018 Mott MacDonald Report Fort Ward.pdf, p. 29 of pdf file.
[24] COOKE_CWA_00074273
[25] COOKE_CWA_00074275
[26] COOKE_CWA_00074277, COOKE_CWA_00074279
[27] COOKE_CWA_00074285
[28] COOKE_CWA_00074287
[29] COOKE_CWA_00074291
[30] 30(b)(6) Cooke Aquaculture Pacific, LLC – Parsons. 103:11–19

No thorough record of repairs was provided to the author. Thus, it is not possible to determine whether Cooke complied with its Pollution Prevention Plan requirement that "Any defective components are to be replaced promptly."

4.3.2.3 Costs Avoided

The costs Cooke avoided annually by not inspecting mooring components deeper than 100 feet were estimated two ways. The first method estimated the costs to hire a contractor to inspect the moorings deeper than 100 feet.

Costs for this method were based on a quote by Collins Engineering[31] prior to their inspections with Mott MacDonald in late 2017. This method, detailed in Appendix 6, estimates that including the deep water mooring components in the annual inspections required by section S6.F of its NPDES permits would have cost Cooke $62,450 per year between 2012 and 2016. In 2017, Mott MacDonald contracted with Collins Engineers to inspect all remaining net pens and moorings after the Cypress 2 collapse. Table 15 shows that Cooke would have expended $42,250 to have the deep water moorings inspected. Similarly, Table 16 shows that the costs to inspect the deep water moorings at Cypress 1 and 3 in 2018 would have been $15,150.

Alternatively, Cooke could have purchased its own ROV and used its own personnel and infrastructure to inspect the deep water anchors. As detailed in Appendix 6, this approach would have cost Cooke at least $23,193 each year from 2012 through 2016. In 2017, Mott MacDonald contracted with Collins Engineers to inspect all remaining net pens and moorings after the Cypress 2 collapse. Table 20 shows that Cooke would have expended $23,193 to inspect the remaining deep water moorings using its own staff. Similarly, Table 22 provides the costs to inspect the deep water moorings at Cypress 1 and 3 in 2018.

5 Permit Requirements: S7 Fish Release Prevention and Monitoring Plan

5.1 NPDES Permit Requirements for the Fish Release Prevention and Monitoring Plan

5.1.1 Facts

Section S7 of the NPDES Permits enumerates the requirements for the Fish Release Prevention and Monitoring Plan. Specific requirements include that the Plan must address "Identification and implementation of technology that will minimize fish escapements" and "Routine procedures and best management procedures used to minimize the risk of escapement from the pens during normal daily operations."

[31] Subconsultant agreement between Mott MacDonald and Collins.pdf, Table 2.

5.2 Permit Plans

5.2.1 Facts

In each Fish Escape Prevention Plans (FEPP), Cooke lists technologies it has employed to reduce the risk of fish escapement. These technologies include "improved cage structure designs"[32]. Employing cage structures that will survive the expected extreme environmental conditions is essential to preventing fish escapes. However, Cooke failed to identify and implement certain critical net pen technologies necessary to prevent escapes. Specifically, conditions at each of its eight sites exceeded the maximum rated conditions specified by the net pen manufacturer.

The FEPP submitted by Cooke from 2009 up to and including January 2017 included the following text:

- "Redundancy and over capacity shall be utilized in the moorage system. Accurate drawings and descriptions of the equipment used, dates of deployment and other relevant information shall be kept by site managers."

Cooke's compliance with its Plan to utilize "Redundancy and over capacity" in the moorage system are examined in the present chapter.

5.3 Capacity of Net Pen Systems

5.3.1 Facts

CAP's sites in Puget Sound employed at least three different types of net pens:

- Marine Construction AS– SystemFarm
- Wavemaster Steel Cage
- Procean AS–Ocean Catamaran

The manufacturer specifies the capacity of each cage with respect to environmental conditions (current speed and significant wave height) and stock net dimensions (width, length, depth, and mesh characteristics). Manufacturer specifications for the Marine Construction AS SystemFarm, the Procean AS–Ocean Catamaran, and the AKVA Group Wavemaster system are listed in Table 3.

[32]COOKE_CWA_00027279

Table 3. Manufacturer specifications for net pen capacity

	Marine Construction AS– SystemFarm[33]	**Procean AS–Ocean Catamaran 200 ton Silo Barge**[34]	**AKVA Group Wavemaster EX-1**[35]
Environment			
Current speed	0.5 m/s	0.5 m/s**	1.0 m/s
Sig. Wave Height	1m, with T_{pk}=4s	*	2.3 m
Design			
Net width	24 m	25 m***	Not specified
Net length	24 m	25 m***	Not specified
Net depth	10 m[36]	20 m**	Not specified
Net twine diameter	Not specified	Not specified	Not specified
Mesh size	50 mm[37]		Not specified
Biofouling	Not specified	50%	Not specified
Mooring tension	Not specified	1000 kg	Not specified
Inspections	Specified monthly, and annual inspection sheets.	Specified weekly, monthly, and annual inspections. Includes specific guidance on when to replace specific components.	Not specified

*If SWH exceeds 1.5 meters, variable loads must be removed from walkways.
**"If the current speed does not exceed 0.5 m/s, then depths greater than 20 meters are allowed providing an adequate engineering studies [sic] is carried out and all factor are taken into consideration."
***For E-version. This is the version shown in the drawings attached to the Procean manual in COOKE_CWA_00000014–COOKE_CWA_00000022.

The BAP standard states that there must be documentation that the farm was installed per the recommendations of a marine engineer or other accredited party.[38] (Appendix 1).

To ensure that that net pens are not operated beyond their rated capacity, the Best Aquaculture Practices standard (refer to quotations in Appendix 1) states that a meteorological and metocean study should be performed using methods in the Norwegian aquaculture standard NS 9415 (Appendix 2).

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[33] 8 20150310161238332.pdf
[34] COOKE_CWA_00026357.pdf
[35] COOKE_CWA_00287359
[36] 8 20150310161238332.pdf
[37] 8 20150310161238332.pdf
[38] Aquaculture Facility Certification: Salmon Farms. Best Aquaculture Practices Certification Standards, Guidelines. 2011, p11.

According to NS 9415, current, wave, and wind conditions with 10-year return periods and 50-year return periods at the local site are to be used when establishing the capacity of the net pen system. Currents must be quantified using a set of rigorous measurements collected over a month at the salmon farm site.

The author found no evidence that rigorous current, wave and wind studies were performed at any of the sites prior to 2017. Cooke provided values for maximum current speed for each site in their permit application documents. However, no basis for these values was provided in the materials reviewed by the author.

On April 9, 2019, the author was provided materials from Dynamic Systems Analysis (DSA). The expected maximum current speeds and significant wave heights calculated by DSA for the Cypress Site 1, Hope Island, and Orchard Rocks sites are included in Table 4. Table 5 summarizes the operating conditions for the net pens at each of the eight net pen sites. Parameters which exceed the net pen manufacturer specifications given in Table 3 are shown in bold italics.

Because DSA's analysis of current speeds were only provided for three sites, the author used current measurements collected by TerraSond[39] using an Acoustic Doppler Current Profiler to estimate the maximum expected currents at each site. This data consisted of 4-minute and 5-minute averaged measurements (ensembles) of the horizontal fluid velocity at 1-meter increments (bins) throughout the water column. For the present analysis, the velocity 5 meters below the water surface was used, as per NS 9415. Current measurements were sorted into eight bins based on the current heading. For each directional bin, the peaks were fit to a two-parameter Weibull distribution and extrapolated to estimate the highest current speed that would occur during an average 50-year interval (the 50-year return period current speed). Here, peaks were defined as any observation that exceeded the mean current speed by more than three standard deviations. This rigorous requirement results in lower estimates of the maximum current than would result from other acceptable thresholds (e.g. those used by DSA). The highest 50-year current speeds from all eight directional bins is reported for each site in Table 5, along with those estimated by DSA.

[39] COOKE_CWA_00242021– COOKE_CWA_00242029

Table 4. Environmental Conditions at Cooke Aquaculture Pacific's Net Pen Sites

		Maximum Expected Current				Maximum Significant Wave Heights		
Site	**Pen Type**	**Allowed by Manufacturer**	**Cooke (Permit Applications)**	**DSA* / TerraSond**	**Dewhurst***	**Allowed by Manufacturer**	**Mott-Macdonald**	**DSA***
Cypress Island #1	8-cage Marine Construction SystemFarm[40,41]	50 cm/s	45 cm/ sec[42],[43]	***176 cm/s***[44]	***132 cm/s***[45]	1m, with T_{pk}=4s	Hsig<4 ft (1.2 m)[42]	***1.47*** m[46]
Cypress Island #2	10-cage Marine Construction SystemFarm[40,47]	50 cm/s	27 cm/ sec[48]		***153 cm/s***[49]	1m, with T_{pk}=4s	Not reported	
Cypress Island #3	12-cage Wavemaster EX-140[40,50]	100 cm/s	45 cm/ sec[51]		***173 cm/s***[52]	2.3 m	Hsig<4 ft (1.2 m) [53]	
Hope Island	10-cage Wavemaster EX-1[40,54,55]	100 cm/s	96 cm/sec[56]	***164 cm/s***[57]	***114 cm/s***[58]	2.3 m	Hsig=4.5 ft (1.4 m), Tp=3 sec[55]	1.318 m[59]
Port Angeles #1	14 cage Marine Construction SystemFarm[40]	50 cm/s	15 cm/sec[60]		42 cm/s[61]	1m, with T_{pk}=4s	***Hsig=5.3 ft*** (1.6 m), Tp=4.3 sec (SE Storm)[62]	
Port Angeles #2	6 cage Marine Construction SystemFarm[40,63]	50 cm/s	15 cm/sec[60]		18 cm/s[64]	1m, with T_{pk}=4s	***Hsig=5.3ft***, (1.6 m), Tp=4.3 sec (SE Storm)[65]	
Fort Ward	12-cage Ocean Catamaran Platform, Procean[40,66]	50 cm/s	110 cm/sec[67] **125 cm/ sec[68]**		***220 cm/s***[69]	**	5 ft (1.5 m)[70]	
Orchard Rocks	Two 10-cage Procean Ocean Catamaran Platforms[40,71]	50 cm/s	110 cm/sec[67] ***115 cm/ sec***[72]	***259 cm/s***[73]	***236 cm/s*** [74]	**	***6 ft*** (1.8 m)[67]	***1.58 m***[75]
Clam Bay	10- and 12-cage Procean Ocean Catamaran Platforms[40]	50 cm/s	90 cm/sec[76] or ***110 cm/sec***[77]		***97 cm/s***[78]	**	Not reported[77]	

[42] 2018 Mott MacDonald DW Site 1 Report.pdf

*Values corresponding to a 50-year return period.

** If SWH exceeds 1.5 meters, variable loads must be removed from walkways.

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[41] 71 17-11-16 Wood Interview.docx
[42] 2018 Mott MacDonald DW Site 1 Report.pdf
[43] FACT SHEET: COOKE_CWA_00033906.pdf
[44] COOKE_CWA_00241528
[45] Cyprus S\Original\DPL8_000.000
[46] COOKE_CWA_00241528
[47] 71 17-11-16 Wood Interview.docx
[48] FACT SHEET: COOKE_CWA_00033961.pdf
[49] Average of Cyprus N\Original\DPL7_000.000 and Cyprus S\Original\DPL8_000.000
[50] 71 17-11-16 Wood Interview.docx
[51] FACT SHEET: COOKE_CWA_00034016.pdf
[52] Cyprus N\Original\DPL7_000.000
[53] 2018 Mott McDonald DW Site 3 Report.pdf
[54] 2018-2-21 Letter – COOKE_CWA_00013517.pdf
[55] 2018 Mott MacDonald Hope Island Report.pdf
[56] COOKE_CWA_00034071.pdf
[57] COOKE_CWA_00241954
[58] Average of Hope N\Original DPL5_000.000 and Hope S\Original DPL5_000.000. However, the Hope Island S ADCP deployment yielded a higher current speed and was closer to the site, so an engineering analysis should consider the higher estimated maximum current of 133 cm/s.
[59] COOKE_CWA_00241954
[60] COOKE_CWA_00034126.pdf
[61] Port Angeles W\Original\DPL10001.000
[62] 2018 Mott McDonald Port Angeles Report 1.pdf
[63] 37 CAP_DOE_0004677.pdf
[64] Port Angeles E\Original\DPL9_000.000
[65] 2018 Mott McDonald Port Angeles Report 2.pdf
[66] 71 17-11-16 Wood Interview.docx
[67] 2018 Mott MacDonald Orchard Rocks Report.pdf
[68] FACT SHEET: COOKE_CWA_00036658.pdf
[69] Bainbridge N\Original\DPL4_000.000
[70] 2018 Mott McDonald Report Fort Ward.pdf
[71] 71 17-11-16 Wood Interview.docx
[72] FACT SHEET: COOKE_CWA_00034236.pdf
[73] COOKE_CWA_00241926
[74] Bainbridge S\Original\DPL3_000.000
[75] COOKE_CWA_00241926
[76] FACT SHEET: COOKE_CWA_00033851.pdf
[77] COOKE_CWA_00013224.pdf
[78] Average of Clam Bay S\Original\DPL2_000.000 and Clam Bay N\Original\DPL1_000.000. However, the Clam Bay S ADCP deployment yielded a higher current speed and was closer to the site, so an engineering analysis should consider the higher estimated maximum current of 125 cm/s.

Table 5. Configuration of Cooke Aquaculture Pacific's Net Pens

		Allowed by Manufacturer				Implemented by Cooke					
Site	**Pen Type**	**Width**	**Length**	**Depth**	**Mesh Size**	**Width**	**Length**	**Depth**	**Twine Diam.**	**Mesh Size**	**Cage Nos.**
Cypress Island #1	8-cage Marine Construction SystemFarm[79,80]	24m[81]	24m[81]	10 m	50 mm	24m[81]	24m[81]	***15m***[81]	1.7mm[81]	***22mm***[81]	
Cypress Island #2	10-cage Marine Construction SystemFarm[40,82]	24m[81]	24m[81]	10 m	50 mm	24m[81]	24m[81]	***15m***[81]	1.7mm[81]	***22mm***[81]	
Cypress Island #3	12-cage Wavemaster EX-1[40,40,83]	24m[81]	24m[81]	Not specified	Not specified	24m[81]	24m[81]	15m[81]	1.7mm[81]	22mm[81]	
Hope Island	10-cage Wavemaster EX-1[40,84,85]	24m[86]	24m[86]	Not specified	Not specified	24m[86]	24m[86]	12m or 13m[86]	1.7mm[86]	20mm[86]	1-10
Port Angeles #1	14 cage Marine Construction SystemFarm[40]	24m or 25m[87]	24m or 25m[87]	10 m	50 mm	24m or 25m[87]	24m or 25m[87]	***12m or 15m***[87]	210/165[87]	1.5[87]	1-14
Port Angeles #2	6 cage Marine Construction SystemFarm[40,88]	24m or 25m[87]	24m or 25m[87]	10 m	50 mm	24m or 25m[87]	24m or 25m[87]	10m or **12m**	210/165 or 210/150[87]	1.25 or 1.5[87]	15-20
Fort Ward	12-cage Ocean Catamaran Platform, Procean[40,89]	25m[90]	25m[90]	20 m	Not specified	25m[90]	25m[90]	15m[90]	2.1mm[90]	20 mm[90]	
Orchard Rocks	Two 10-cage Procean Ocean Catamaran Platforms[40,91]	25m[90]	25m[90]	20 m	Not specified	25m[90]	25m[90]	15m[90]	2.1mm[90]	20 mm[90]	
Clam Bay	10- and 12-cage Procean Ocean Catamaran Platforms[40]	25m[92]	25m[93]	20 m	Not specified	25m[93]	25m[93]	15m[93]	264ply or 2.1mm[93]	20mm or 36mm[93]	

79 COOKE_CWA_00017123.pdf
80 71 17-11-16 Wood Interview.docx
81 COOKE_CWA_00000096.xlsx
82 71 17-11-16 Wood Interview.docx
83 71 17-11-16 Wood Interview.docx

[84] 2018-2-21 Letter – COOKE_CWA_00013517.pdf
[85] 2018 Mott MacDonald Hope Island Report.pdf
[86] COOKE_CWA_00000209.xlsx
[87] COOKE_CWA_00000297 (COOKE_CWA_00000277.pdf)
[88] 37 CAP_DOE_0004677.pdf
[89] 71 17-11-16 Wood Interview.docx
[90] COOKE_CWA_00000247.xlsx
[91] 71 17-11-16 Wood Interview.docx
[92] COOKE_CWA_00026379.xlsx
[93] COOKE_CWA_00026379.xlsx

CONFIDENTIAL

5.3.2 Analysis and Discussion

5.3.2.1 Compliance

CAP's NPDES permits require the "Identification and implementation of technology that will minimize fish escapements". Furthermore, CAP's Fish Escape Prevention Plans from 2009 to 2017 provide that "Redundancy and over capacity shall be utilized in the moorage system." However, Table 4 and Table 5 show that conditions at each of its eight sites exceeded the maximum rated conditions specified by the net pen manufacturer. The loads at these sites exceed the maximum rated conditions either by exceeding the maximum current speed, significant wave height, net depth, or a combination thereof.

The Cypress Island 1 net pen system used stock nets that were 50% deeper than those prescribed by the manufacturer. These nets also had a mesh size (spacing) that was less than half that specified by that manufacturer. That is, the solidity of the net panels were more than double those specified by the manufacturer. These two modifications result in the nets having an overall projected area more than 300% of that of the nets specified by the manufacturer. For a given steady current speed, the horizontal fluid drag force on a net is nominally proportional to projected area. Furthermore, the maximum expected 50-year current speed was about 2.5 times that specified by the manufacturer. Fluid drag force is generally proportional to the square of fluid speed, so a current speed of 2.5 times the rated value produces a drag force more than 6 times the drag force associated with the rated current. The combined effects of the increased drag area of the nets and the excessive current speeds result forces on the system that are far greater than those for which the structure was designed.

Similarly to Cypress Island 1, the Cypress Island 2 net pen system employed nets whose depth exceeded the maximum manufacturer-specified net depth and whose net mesh size was smaller than the minimum allowed for by the manufacturer. Furthermore, the maximum expected current at Cypress Island 2 was more than three times that specified by the manufacturer.

The author's conservative (low) estimate of the maximum expected currents at Cypress Island Site 3 were 75% higher than those allowed by the manufacturer.

The author's conservative (low) estimate of the maximum expected currents at Hope Island were 14% higher than those allowed by the manufacturer. The Port Angeles net pen systems exceeded the manufacturer's rating for net depth. Furthermore, the 50-year return period significant wave height is larger than the maximum allowable significant wave height specified by the manufacturer.

For the Fort Ward, Orchard Rocks and Clam Bay sites, the expected maximum current speeds are, respectively, 4.1, 4.2, and 2.0 times the maximum current speeds specified by the manufacturer. It is noted that the net depths at these sites are less than the maximum allowed by the manufacturer (15 m, compared to the maximum allowable depth of 20 m in currents up to 0.5 m/s). However, since the drag forces associated with the maximum expected currents at these sites will produce drag loads that are approximately 16.8, 17.6, and 4.0 times those associated with the maximum current speed specified by the manufacturer, the reduced net depth does not sufficiently offset the increased load on the net pen system due to the excessive current speeds.

Net pen systems operated under conditions that exceed the manufacturers' ratings are at risk of partial or catastrophic failure during instances of extreme environmental loading, which can result in fish escapement.

Compliance with manufacturers' specifications is necessary to ensure that net pen structures will be capable of surviving the expected extreme environmental conditions. Manufacturers' specifications and BAP guidelines require that system configurations that deviate from manufacturers' specifications must be approved by a marine engineer or by another accredited party. In the absence of a marine engineer's analysis demonstrating the safety of the system, net pen systems that do not comply with manufacturers' specifications are at risk of structural failure. The risk of failure at each of these sites was exacerbated by the apparent lack of rigorous analyses of maximum current speed for any site prior to 2017. The apparent lack of rigorous analyses of maximum current for certain remaining sites to date further exacerbates the risk of structural failure at these sites. In relation to the issues described above, Cooke failed to identify and implement technology that will minimize fish escapements at its eight Puget Sound net pen sites and failed to utilize redundancy and over-capacity in the moorage systems.

5.3.2.2 Costs Avoided

The risk of recurring or catastrophic structural failures at the sites could have been reduced by performing the rigorous analysis of 10-year and 50-year maximum current speeds as required by BAP. A budgetary estimate for the measurement and analysis work required by BAP was obtained from ASL Environmental Sciences Inc., of Victoria, B.C. The cost of this analysis for a single site—exclusive of airfare and lodging for the field technician—would be $18,284. Appendix 5 extrapolates this quote to estimate the cost of quantifying the maximum expected currents at each of seven net pen locations in three different areas (Bellingham Channel, Hope Island, and Rich Passage). Since published literature[94] suggests currents in Port Angeles are below the 0.5 m/s speed allowed by the manufacturer, a current study in Port Angeles was not included in this estimate. Using the conservative assumptions detailed in Appendix 5, quantifying the maximum expected currents at seven net pen locations would have entailed a one-time cost of at least $77,954, in 2019 USD. Since these studies were required by BAP standards, Cooke had annual opportunities back through Sept. 14, 2012 to acknowledge the need for these studies and authorize their execution.

In addition to requiring a rigorous analysis of maximum current speeds at each net pen location, manufacturers' specifications and BAP guidelines require that system configurations that deviate from manufacturers' specifications must be approved by a marine engineer or by another accredited party. Based on the author's professional experience, the simplest possible analyses of this nature require the engineering effort summarized in Table 6. These costs assume that the marine engineer has an existing numerical model of the basic net-pen system that can be adjusted to reflect the specific configuration and environmental conditions at the site in question.

Table 6. Minimum required engineering effort to assess variations on mooring configuration or net configuration. Assuming a rate of $125 for a marine engineer.

Task	Hours	Costs

[94]Ebbesmeyer, C. C., et al. "Dynamics of Port Angeles Harbor and Approaches." Prepared for the MESA (Marine Ecosystems Analysis) Puget Sound Project (1979).

Structural parameter identification	8	$1,000
Hydrodynamic parameter identification	8	$1,000
Model building and verification	8	$1,000
Model analysis	8	$1,000
Final reporting	8	$1,000
Total	**40.0**	**$5,000**

Conditions at each of Cooke's eight sites exceed the maximum rated conditions specified by the net pen manufacturer. Thus, Cooke should have conducted an engineering analysis for nine different net pen systems (Port Angeles comprises two separate cage systems), for a total one-time cost of $45,000, in 2019 USD. Since these studies were required by BAP standards, Cooke had annual opportunities back through Sept. 14, 2012 to acknowledge the need for these studies and authorize their execution.

Since the currents at Port Angeles are below the maximum speed allowed by the manufacturer, and only the estimated 50-year return period significant wave height at Port Angeles exceeds the value allowed by the manufacturer, it is possible that an engineering analysis would show that reducing the net depth to the specified sizes would allow the system to survive the maximum expected environmental conditions. For the remaining seven sites, the current speeds exceed those specified by the manufacturer by such a large margin that it is unlikely that the raft systems operated by Cooke as of 2017 could achieve the safety factors required by NS9415 or any international standard in the maximum expected environmental conditions, even if the net depths were reduced. Therefore, Cooke would have needed to upgrade its infrastructure with more robust net pen systems at Cypress Island #1, #2, and #3, Hope Island, Fort Ward, Orchard Rocks, and Clam Bay. Appendix 7 shows that the costs avoided by not upgrading to sufficiently robust net pen systems is approximately $26,440,000. Cooke had annual opportunities to incur this one-time cost between Sept. 14, 2012 and the present.

Potential costs avoided, not estimated here, include the costs of relocating net pen operations to sites with less extreme current speeds. Furthermore, the economic gains associated with the increased net sizes were not calculated in this report.

6 Cypress Island Net Pen Collapse

The purpose of this chapter is to assess whether the catastrophic failure of Cooke's Cypress 2 net pen in August 2017 is attributable in part to Cooke's failure to identify and implement appropriate technology and best/appropriate industry standards and practices. This chapter is focused on evaluating the effects of Cooke's deviations from its Permit requirements—as described in the preceding chapters—on the failure of the Cypress Site 2 net pen.

6.1.1 Chronology

6.1.1.1 Facts

A perfunctory chronology of the events leading up to the catastrophic failure is given in Table 7.

Table 7. Chronology of Events Regarding Cypress Island Site 2

Following events were extracted from source "Response to the Administrative Order issued to Cooke Aquaculture Pacific, LLC, Docket Number 15422"[95]

7/24/17	Mooring failure at Site 2. Ten anchor points on cages had failed, other anchors dragged
7/25/17	Moorage anchors failed again, cages shifted off the permit site
7/26/17-7/29/2017	Crew worked to "...reset and replace the mooring system for the Site 2 facility." "This involved replacement of the mooring system and attachment points for the entire facility."
8/19/2017	Another mooring failure. Two anchors failed, three others dragged, one anchor had a broken pad eye, safety chain and cleat.
8/20/2017	Corner anchor failed. Staff could not reattach line. Corners of cages became submerged
8/21/2017	Some walkways started twisting
8/22/2017	Currents too high for divers
8/23/2017	Site 2 was total loss
2/9/2018	Cooke reported that all debris was removed from the sea floor.[96]

6.2 Net Cleaning

6.2.1 Facts

The July and August 2017 incidents were widely attributed by Cooke staff to excessive biofouling on the Site #2 nets. Examples are quoted below.

Cooke stated that "a slowdown in net cleaning occurred prior to the July incident because of mechanical issues related to the net cleaning equipment."[97]

The following text appears in a document entitled *Cypress Island, July 2017 results*[98] prepared by Cooke Aquaculture Pacific:

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On Monday July 24th Site 2 lost approx. 10 moorings and several anchor
points drug. During the rest of the week the site was reanchored in
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[95] 155 Cooke_s_Response_to_Agreed_No._Order_15422.pdf
[96] COOKE_CWA_00047613
[97] em_atlantic_salmon_cooke_investigation_response.pdf
[98] COOKE_CWA_00130821.pdf

> place and feeding resumed on Saturday July 29. No stock was lost and mortality was very low. This failure was due to fouled nets and weak mooring points.

In the same document, under the heading "Cypress Island – Net hygiene:"

> Cypress Island - Net hygiene
>
> - MPI and Idema running, Stingray has been problematic, welds on the wash head continue to break.
>   - o New wheels arrived Monday, Aug. 7.
> - Site 2 and 1 walls are washed, moving to site 3 and continuing to address floors.

The same text appears in the net hygiene section of another document entitled *Cypress Island, September 2017 results*[99].

A quotation from an August, 2017 *Production Report from Cooke Aquaculture Pacific*,[100] under the heading *Innes- Farm Sites and Marine Managers Discussion* is:

> Problem- Failure and unreliability of net washing systems was a factor in both instances of Clam Bay and Site 2 breaking moorings. Both farms fell behind in keeping up with net hygiene. Increased drag during extreme tides snapped moorings.
> Keeping nets clean especially during spring summer rapid fouling growth periods and hard tidal exchanges is critical.
> - Are the net washers functioning at all times? No.
> - What can we do to correct that problem?
> Solutions:
>
> - Have common breakdown replacement parts available on site. Keep extra 2 to 3 of each part available at each of the sites in inventory.
>
> **Action Item (to be done by Friday):** Tom, Bill, Brandon write up a list of common breakdown points and issues for the MPI and the StingRay. Make a list of parts that would be needed to do on site quick repairs.
>
> **Tom, Brandon or Bill-** Designate a single person to order up enough parts for each farm area to have 2 to 3 extra parts available for each machine they operate.
>
> **Site Managers-** Keep parts on each site and keep an inventory of your parts. Order a new replacement part when you use one of these spare parts.

According to an interview with Matt Fitzgerald, Cooke Aquaculture Site 1 Raft Supervisor, regarding the August incident:

> Nets need more cleaning in the summer. Broken net washers affected the cleaning schedule. Fouling at Site 2 was "7 out of 10", it is usually "4 out of 10"[101].

According to an interview with Sky Guthrie, Cypress Island Manager:

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[99] COOKE_CWA_00131215.pdf
[100] 115 COOKE_CWA_00130914.pdf
[101] 106 17-11-9 Fitzgerald.pdf

Fouling on a scale of 1-10, 2-3 is ideal, probably ~8 after July[102]

6.2.2 Analysis and Discussion

6.2.2.1 Compliance

No photographic or quantitative measure of the effectiveness of net cleaning between the July and August incidents was reviewed by the author. Thus, it is impossible to quantify the extent to which biofouling increased the drag on the net pens at the time of the August collapse. But the reports from Cooke staff quoted above indicate that significant levels of biofouling were present on the Cypress Site 2 nets. It is noted that Mr. Fitzgerald's comment specifically was in regard to the August incident. Thus, based on Cooke employees' observations, it is reasonable to conclude that biofouling levels could have exceeded those accounted for by the cage manufacturer, resulting in increased drag loads, leading to broken mooring attachments and dragged anchors.

6.2.2.2 Costs Avoided

Cooke's maintenance supervisor partially attributed the net washers' breakdowns to inadequate care by workers.[103] However, quantifying the cost of improved training or maintenance is beyond the scope of this report. Additionally, Cook could have replaced stock nets rather than focusing on cleaning alone. However, quantifying the economic implications of such a decision is outside the scope of this report.

6.3 Inspections and Maintenance

6.3.1 Analysis and Discussion

6.3.1.1 Compliance

It is noted that, during and after the July 2017 incident, Cooke expended significant effort inspecting and repairing components. However, prior to July 1, 2016, anchors at Cypress Site 2 went three years and nine months[104] without a documented inspection of the complete mooring system.

While no cohesive record of issues and repairs at Site 2 was reviewed by the author, it is noted that Cooke expended significant effort repairing and replacing components after the July incident. However, modifications to the net pen design and mooring plan were made without consulting a marine engineer.[105] For example, the "chain exoskeleton" installed after the July incident may have contributed to the catastrophic failure in August by applying loads to the anchor attachment points that were not accounted for in the design of those points.

[102] 70 17-12-1 Guthrie Interview.docx
[103] 17-12-6 Clark Interview.docx
[104] COOKE_CWA_00018363-Site 2.xlsx
[105] 30(b)(6) Cooke Aquaculture Pacific, LLC - Parsons Vol 1. p207-08.

6.3.1.2 Costs Avoided

The decisions to deviate from the net pen design and mooring plan specified by the net pen manufacturer were apparently made without the evaluation or guidance from a marine engineer.[106] Based on the author's professional experience, the simplest possible analyses of this nature require the engineering effort summarized in Table 8. These costs assume that the marine engineer has an existing numerical model of the basic net-pen system that can be adjusted to reflect the specific configuration and environmental conditions at the site in question. While it is impossible to project what the outcomes of an initial engineering assessment would have been, a conservative estimate of the cost to hire a marine engineer to evaluate the effects of installing the "chain exoskeleton" in July 2017 yields an avoided cost of $10,000, in 2019 USD.

Table 8. Minimum required engineering effort to assess variations on mooring configuration or net configuration. Assuming a rate of $125 for a marine engineer.

Task	Hours	Costs
1. Hydro-/structural dynamic model		
Structural parameter identification	8	$1,000
Hydrodynamic parameter identification	8	$1,000
Model building and verification	8	$1,000
Model analysis	8	$1,000
2. Finite element model of mooring attachment subject to loads from mooring and "exoskeleton"		
Geometry and material property identification	8	$1,000
Model building and verification	24	$3,000
Model analysis	8	$1,000
Final reporting	8	$1,000
Total	**80.0**	**$10,000**

6.4 Capacity of Net Pet Systems

6.4.1 Facts

Table 3 and Table 5 show that the nets on the Cypress Island Site 2 pen were 50% deeper than those allowed by the net pen manufacturer and had a mesh size less than half that specified. As described in 5.3.2, these two modifications result an overall increase in the fluid drag force of 300%. Furthermore, the system was operated in a location with expected extreme currents three times those allowed by the cage system manufacturer. Thus, rather than identifying and implementing "technology that will minimize fish escapements" as required by condition S7.1 of

[106] 30(b)(6) Cooke Aquaculture Pacific, LLC - Parsons Vol 1. p207-08.

its NPDES permit, Cooke increased the risk of fish escapements by increasing the risk of structural failure.

Furthermore, the mooring system differs from that recommended by the manufacturer. The mooring design at the time of the structural failure in July, 2017, is described in a document, "COOKE_CWA_00018363-Site 2.xlsx". After the failure in July, 2017, the revised mooring system is described in "COOKE_CWA_00018184.xlsx". The latter document was in effect at the time of the complete pen collapse in August, 2017. It differs significantly from the layout specified in the SystemFarm manual.

The Best Aquaculture Practices (BAP) standard states that there must be documentation that the farm was installed per the recommendations of a marine engineer or other accredited party[107]. Two analyses of the Cypress Site 2 system were reviewed by the author. The first is in the form of an Excel workbook[108] and a corresponding PDF[109]. These have no author or date listed. They do not report the assumptions or calculations that were used to generate the results. These documents report "rope safety factors" of 0.3 to 1.3 for the various anchor lines analyzed for Cypress Site 2. The second analysis of the Cypress Site 2 system is summarized in a report from a Norwegian company, Aqua Knowledge, dated April 16, 2015[110]. This analysis reports the safety margins for the mooring lines are "OK." It should be noted, however, that this report details the stock nets included in the analysis, but makes no mention of including a predator net. Furthermore, the mooring configuration differs from what was present at Cypress Site 2 before the August collapse. Both of the analyses show 22 anchors at Cypress Site 2. However, the mooring diagram provided by Cooke update 8/3/2017 shows only 20 anchor lines at Site 2.[111] Neither of these analyses report safety factors for the structural components of the raft (e.g. mooring points).

6.4.2 Analysis and Discussion

6.4.2.1 <u>Compliance</u>

The Cypress Island 2 net pen system used stock nets that were 50% deeper than those prescribed by the manufacturer. These nets also had a mesh size that was less than half that specified by that manufacturer. These two modifications result in the nets having an overall projected area more than 300% of that of the nets specified by the manufacturer. For a given steady current speed, the horizontal fluid drag force on a net is nominally proportional to projected area. Furthermore, the fluid drag is nominally proportional to fluid speed squared. Since the system was operated in a location with expected extreme currents three times those allowed by the cage system manufacturer, the total drag loads under an extreme current event could be as high as 27 times those allowed by the manufacturer in the design process.

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[107] Aquaculture Facility Certification: Salmon Farms. Best Aquaculture Practices Certification Standards, Guidelines. 2011, p11.
[108] COOKE_CWA_00017135.xls
[109] 20 Icicle_Seafoods_Deep_Harbor.pdf
[110] COOKE_CWA_00013573.pdf
[111] COOKE_CWA_00018184.xlsx

Given the discrepancies between the manufacturer's specifications and the configuration of the net pen system, the system required the analysis of a marine engineer or other accredited party[112]. Two analyses were reviewed. The analysis in COOKE_CWA_00017135.xls appears to be based on observations of how far various mooring buoys submerged when their mooring lines were under tension. This spreadsheet shows "rope safety factors" from 0.3 to 1.3 for the various anchor lines analyzed for Cypress Site 2 when incorporating load factors and material factors similar to those prescribed in NS9415. Safety factors lower than 1.0 indicate failure. The report by Aqua Knowledge concluded that the safety margins in the mooring lines were "OK". This analysis lists the correct dimensions of the stock nets that were used, but makes no mention of a predator net. The basis of the current speeds used in this analysis is not stated.

A subset of daily logs for Cypress Site 2 related to structural concerns were reviewed by the author. The logs do not provide a clear record of structural issues. However, the apparent repeated breaking or bending of anchor attachment points[113,114,115, 116] and the occurrence of cracks in the steel structure[117,118] are consistent with a net pen system that was being operated under loads that were higher than those for which it was designed. These excessive drag forces would be due to oversized nets with a fine mesh and current speeds significantly higher than those allowed by the manufacturer.

6.4.3 Costs avoided

Performing a rigorous study of the maximum currents at Site 2 would have informed Cooke whether the Marine Construction SystemFarm pen technology was sufficiently robust as to prevent fish escapes due to structural failure at the site. As described in Section 5.3.2.2, this study, conducted only for Cypress Site 2, would have cost Cooke over $18,284.

In addition to performing a rigorous study of the maximum current speeds at the site, Cooke should have used the net size specified by the net pen manufacturer. The economic losses associated with using this smaller net size are outside of the scope of this report.

6.5 Summary: Cypress Island Net Pen Collapse

As a result of excessive loads on the Cypress Site 2 net pen system created by:

- Currents, net sizes, and net solidity exceeding those specified by the net pen manufacturer,
- biofouling levels potentially exceeding design values, and
- mooring system installations and repairs that deviated from manufacturer recommendations and were not approved by a marine engineer,

[112] Aquaculture Facility Certification: Salmon Farms. Best Aquaculture Practices Certification Standards, Guidelines. 2011, p11.
[113] 20160222_ShackleAt15CornerBendInBracketsHoldingBoxBeams.pdf
[114] 20160202_CockeyedPadeyeAt21Corner.pdf
[115] 20150212_AnchorsLookGoodAnchorPointStillNeedFix.pdf
[116] 20141125_8StressCracks211AnchorEyeStillNeedsFix.pdf
[117] 20141002_8CracksTeensSide1Crack221.222Outside.pdf
[118] 20150116_AnchorsLookGood8CracksPlus1.pdf

the Cypress Site 2 net pen system was at risk of partial or catastrophic failure when subjected to the expected extreme tidal currents. Thus, these factors likely contributed to the partial and catastrophic failures that occurred when the system was subjected to these tidal currents in the summer of 2017.

7 Recommendations

In order to avoid or mitigate the risk of failure under future extreme environmental loading events at Cooke's net pens, to better respond to partial or total failures if they occur, and for Cooke to comply with its NPDES permits, the author makes the following recommendations, to the extent they are consistent with Cooke's NPDES permits:

- Cooke should complete rigorous current speed analyses at all sites and adjust net pen engineering and siting if necessary.
- Cooke should bring all net pen sites within the maximum rated conditions specified by the net pen manufacturer, including but not limited to maximum current speed, significant wave height, and net dimensions. Alternatively, net pen systems that deviate from manufacturers' specifications should be evaluated and approved by a marine engineer according to industry standards. This engineering analysis must consider the structural integrity of the mooring system <u>and</u> the net pen structure.
- Cooke should ensure that engineering analysis takes into account the actual dimensions, mesh size, and twine diameter of all nets on each net pen system when determining whether sites are within maximum rated conditions.
- Mooring systems and net pen cage structures should be shown to include "redundancy and over capacity" as stated in Cooke's Fish Escape Prevention Plans and as required by industry standards.
- Maximum biofouling on nets should not exceed levels accounted for in the design of the net pen structure and mooring system.
- Cooke should develop a Standard Operating Procedure for future partial or total failures of net pens that, at a minimum, requires consultation with a marine engineer and an attempt to identify the cause(s) of the failure.
- Cooke should inspect all portions of mooring systems on an annual basis as required by NPDES permits, including visual inspections via dive teams or via ROV of all anchoring components below 100 feet in depth.
- Cooke should conduct thorough "annual" inspections of the full main cage structures that are not part of daily, weekly, or monthly inspections and prioritize necessary maintenance identified through these inspections.

Appendix 1 Best Aquaculture Practices for Salmon – Control of Escapes

The Global Aquaculture Alliance (GAA), Portsmouth, NH (formerly St. Louis, MO) creates and maintains an industry standard called:

> **Aquaculture Facility Certification**
> **Salmon Farms**
> **Best Aquaculture Practices Certification Standards, Guidelines**

GAA released versions of this standard as described in Table 9. According to these standards, either Version 2, Rev. 2 or Issue 2, Revision 3 applied at the time of the Cypress Site 2 pen collapse in August, 2017.

The current version of the BAP Salmon Farm Standards is Issue 2, Revision 3 October 2016. The standard is available from:

Global Aquaculture Alliance
Best Aquaculture Practices
85 New Hampshire Avenue, Suite 200
Portsmouth, NH 03801 USA

Table 9. Versions of *Aquaculture Facility Certification, Salmon Farms, Best Aquaculture Practices*

Release Date	Version Designation (in document)	Applicability
6/2011	Initial Release	(open ended)
5/2015	Version 2 – Rev 2, May 2015	Replaces Initial Release, valid until October 15, 2017
10/2016	Issue 2 – Revision 3	October 2016 Onward

An excerpt from this document follows. The only change between the text in the three versions of the standard is the omission of the word “that” in the third bullet item of the May 2015 version as compared to the earlier version.

6. Environment

Control of Escapes

Salmon farms shall take all practical steps to prevent escapes and minimize possible adverse effects on aquatic wildlife if escapes occur.

...

Implementation

...

Escape Prevention

- A classification of the farm site based on expected wave heights and currents based on local estimates of 10- and 50-year maximum wind speeds and directions using the method proposed in NS9415 or equivalent.

- A report from a qualified marine engineer or accredited third-party that confirms the farm structure design and installation are appropriate, given the 10- and 50-year site conditions estimated in the site classification
- Documents that show ~~that~~ the farm's moorings were installed according to the manufacturer's and/or marine engineer's specifications.

...

- Procedures that require the main surface components of the system to be inspected by qualified inspectors at least annually and repaired or replaced as needed. The sub-surface components must be inspected and replaced, as needed, at least every two years or between each crop cycle, whichever is shorter. Equipment shall be replaced as needed.
- Net inventory management procedures that track the ages of all nets on the farm or in storage, and provide strength tests on all nets between crops or every two years, whichever period is shorter. Nets shall be retired when their strength is below levels specified in local regulations or, where there are none, below the manufacturer's or supplier's recommendations.
- Cage inspection procedures that ensure all operational nets are surface checked for holes at least weekly and checked sub-surface at least every four weeks. Nets and cage superstructure shall be checked for holes and other indications of structural damage after risk events such as storms or big tides.

...

- A training program for all staff, which shall be part of their initial training, on all procedures in the Fish Health Containment Plan.

Standards

...

6.3 The applicant shall provide documents to show that all staff members have received training in the Fish Containment Plan, which shall be verifiable by training certificates in employees' files and verified at audit by a subset of interviews.

Appendix 2 NS 9415

The following text is quoted from Norwegian Standard NS 9415.E:2009 entitled *Marine fish farms, Requirements for site survey, risk analyses, design, dimensioning, production, installation and operation.*

5 Site surveys

...

5.2 Determination of velocity of current

5.2.1 General

Either para. 5.2.2, 5.2.3. or 5.2.4. shall be used in determining current velocities.

Measurements shall be done at a minimum of two levels, 5 m and 15 m respectively below sea level, where topography allows.

Measurements shall be undertaken at a place at the site which is expected to have the highest current velocities and shall be representative of the areas where the fish farm is to be located. The measurement site shall be indicated and justified. Logging of current shall take place at least every 10 minutes and form the basis for the dimensioning current velocity at the site. Previous measurements which are logged every 30 minutes can be used when current data is to be collated for a complete year.

Measurement of current velocity entails registration of both time, velocity and direction during the whole of the measurement period. Current measurements shall take place in accordance with NS 9425-1 and/or NS 9425-2, dependent on the bottom depth of the site and exposure.

Which critical current components contribute to the total current overview shall be assessed and documented:

- tidewater current;
- wind-induced surface current;
- outbreak from the coastal current;
- spring flood because of snow and ice melting.

Quality assessment of measurement data of current measurements shall be performed, and include:

- credibility;
- factors during the measurement period that can have affected the measurements.

5.2.2 Measurements of current for one year and use of long-term statistics

...

5.2.3 Measurement of current for one month

...

5.2.4 Use of previous current measurements

...

Appendix 3 NPDES Permits

Site	Primary Permit	Renewal Application Package, Salmonid NPDES Discharge Application	Permit, Fact Sheet
Clam Bay	WA-003152-6	(Original) COOKE_CWA_00052126.pdf (Modified) COOKE_CWA_00030411.pdf COOKE_CWA_00052170.pdf	COOKE_CWA_00030478.pdf COOKE_CWA_00033851.pdf
Cypress Site 1: Deepwater Bay	WA-003156-9	COOKE_CWA_00034878.pdf COOKE_CWA_00054113.pdf	COOKE_CWA_00054233.pdf COOKE_CWA_00033906.pdf
Cypress Site 2: Deepwater Bay	WA-003157-7	COOKE_CWA_00034906.pdf COOKE_CWA_00054769.pdf	COOKE_CWA_00019607.pdf COOKE_CWA_00033961.pdf
Cypress Site 3: Deepwater Bay	WA-003158-5	COOKE_CWA_00034934.pdf COOKE_CWA_00055402.pdf	COOKE_CWA_00055523.pdf COOKE_CWA_00034016.pdf
Fort Ward, Saltwater II	WA-003153-4	COOKE_CWA_00036683.pdf COOKE_CWA_00052786.pdf	COOKE_CWA_00036658.pdf COOKE_CWA_00036658.pdf
Site 4 - Hope Island	WA-003159-3	COOKE_CWA_00034992.pdf COOKE_CWA_00056049.pdf	COOKE_CWA_00056165.pdf COOKE_CWA_00034071.pdf
Orchard Rocks, Saltwater IV	WA-003154-2	COOKE_CWA_00035020.pdf COOKE_CWA_00053432.pdf	COOKE_CWA_00053496.pdf COOKE_CWA_00034236.pdf
Port Angeles, Ediz Hook Site	WA-004089-4	COOKE_CWA_00035047.pdf COOKE_CWA_00056681.pdf	COOKE_CWA_00056738.pdf COOKE_CWA_00034126.pdf

A3.1 MARINE/FRESHWATER SALMONID NET-PEN NPDES WASTE DISCHARGE PERMIT APPLICATION CURRENT SPEEDS

Text common to all of the *Marine/Freshwater Salmonid Net-Pen NPDES Waste Discharge Permit Application Forms*, Section B. Background Information:

Table 10. Current Information provided in Permit Renewal Application Packages

Site	Direction of dominant current from the net-pen(s)	Est. mean current (midway between net-pen bottom and sea floor, cm/sec)	Max. current (midway between net-pen bottom and sea floor, cm/sec)
Clam Bay	West	15	90
Site 1, Deepwater Bay	West	25	45
Site 2, Deepwater Bay	South	25	35
Site 3, Deepwater Bay	South	35	65

Site	Direction of dominant current from the net-pen(s)	Est. mean current (midway between net-pen bottom and sea floor, cm/sec)	Max. current (midway between net-pen bottom and sea floor, cm/sec)
Fort Ward, Saltwater II	West	40	125
Site 4 – Hope Island	North	35	95
Orchard Rocks – Saltwater IV	West	35	115
Port Angeles – Ediz Hook	West	5	20

Appendix 4 Tobias Dewhurst—CV

Tobias Dewhurst

Hydrodynamics Engineer
Maine Marine Composites

SPECIALIZATIONS

Wave-structure Interaction | Hydrodynamics | Marine Renewable Energy | Aquaculture
Numerical Modeling | Wave/tow Tank Testing | Field Experiments| Data Analysis, Visualization

A4.1 Experience

Maine Marine Composites *Project Engineer* September 2016–Present

Secured and managed commercial consulting projects and federally funded research projects in the design and analysis of ocean systems. Industries include marine renewable energy (wave, tidal, and floating offshore wind), aquaculture, lifting and construction applications, and various novel systems exposed to waves and currents.

University of New Hampshire December 2016

Doctor of Philosophy, Mechanical Engineering

Dissertation: *Dynamics of a Submersible Mussel Raft System*

Master of Science, Ocean Engineering May 2013

Thesis: *Muskeget Channel Tidal Energy Test Facility*

Cedarville University December 2009

Bachelor of Science, Mechanical Engineering

Minors in Math, International Business (courses at Dublin Business School, Ireland)

A4.2 PEER REVIEWED PUBLICATIONS

Dewhurst, T., Hallowell, S.T., & Newell, C.R., 2019. *Dynamics of an Array of Submersible Mussel Rafts in Waves and Current.* Proc. of the 38th Conf. on Ocean, Offshore and Arctic Engineering, Glasgow. Accepted.

Simulation of an Axisymmetric, Pneumatic-PTO WEC in Operational and Survival Conditions for Model-Based Design, 2018. Dewhurst, T., MacNicoll, M, Akers, R. *Marine Energy Tech. Symposium Proc.*

Testing and Modelling the RTI F2 QD WEC (2017). Rohrer, J., Weise, N., Dewhurst, T., MacNicoll, M,. EWTEC 2017.

Dynamics of Submersible Mussel Rafts in Waves and Current. Wang, X., Swift, M. R., Dewhurst, T., Tsukrov, I., Celikkol, B., and Newell, C. 2015 China Ocean Engineering Journal, 29(3).

Dynamics of a Floating Platform Mounting a Hydrokinetic Turbine. Dewhurst, T., Swift, M. R., Wosnik, M., Baldwin, K., DeCew, J., & Rowell, M. 2013. Marine Technology Soc. Journal, 47(4).

Dewhurst T; Swift MR; Baldwin K; Wosnik M (2016) Design of a Mooring System for an Inertia Tube Wave Energy Converter. *Marine Energy Tech. Symposium Proc.*

Swift MR; Baldwin K; Bezerra, CAD; Dewhurst T; Sullivan, C (2016) A Student Designed and Built Wave Energy. *Marine Energy Tech. Symposium Proc.*

Dewhurst T; Rowell M; DeCew J; Baldwin K; Swift MR; Wosnik M (2012) Turbulent inflow and wake of a marine hydrokinetic turbine, including effects of wave motion. *Bull. Amer. Phys. Soc.*, Vol.57. No.17, p.146

A4.3 CONFERENCE PRESENTATIONS AND PUBLICATIONS (Selected)

World Aquaculture Society Annual Meeting 2019
Dynamic Finite Element Modeling of a Macroalgae Longline Segment
Engineering Analysis of a Mooring Grid for an Array of Submersible Mussel Rafts
Spatial Extrapolation of Design Wave Conditions from a National Data Buoy Center Platform to a Local Aquaculture Site using Short-Term Measurements

Milford Aquaculture Seminar/Northeast Aquaculture Conference 2019
Analysis of an Array of Submersible Mussel Rafts in Storm Conditions
Design Considerations for a Kelp Longline Exposed to Waves and Currents
An instrument for measuring in-situ tensions in mooring system aquaculture gear

MTS/IEEE OCEANS 2018
A Design of Experiments based approach to engineering a robust mooring system for a submerged ADCP
Wave-to-Wire Modeling and Simulation of a Wave Energy Converter for Off-Grid and Micro-Grid Applications

World Aquaculture Society Annual Meeting 2018
Hydrodynamic characteristics of macroalgae grown on a long-line aquaculture system from physical model tests.

National Shellfisheries Association Annual Meeting 2017
Evaluation of a Submersible Mussel Raft for Use in Semi-Exposed Sites: Field Study
Evaluation of a Submers. Mussel Raft for Use in Semi-Exposed Sites: Numerical Modeling

Milford Aquaculture Seminar/Northeast Aquaculture Conference 2017
Evaluation of a Submersible Mussel Raft for Use in Semi-Exposed Sites

National Shellfisheries Association Annual Meeting 2014
Dynamics of a Submersible Mussel Raft in Waves and Current

Marine Renewable Energy Technical Conference 2013
Dynamics of a Surface Platform for Testing Hydrokinetic Turbines

UNH Graduate Research Conference 2013
Design Alternatives for the Muskeget Channel Tidal Energy Test Site

Global Marine Renewable Energy Conference 2011

Muskeget Channel Tidal Energy Test Site

A4.4 HONORS

Joan and James Leitzel Award for Excellence in STEM Education and Outreach April 2015

UNH Dissertation Year Fellowship 2015-16

Best Presentation—UNH Marine School Graduate Research Symposium April 2015

Muhammad Yunus New Hampshire Social Business Innovation Challenge—3rd place September 2013

Outstanding Mechanical Engineering Senior in Design May 2009

Daniel Award for Scholarship and Character May 2009

NAIA Scholar Athlete December 2008

A4.5 TEACHING

ME 526 – Mechanics of Materials, TA 2013

Teaching one recitation class per week, grading, one-on-one help, review sessions

ME 747 – Experimental Measurement and Modeling of Complex Systems, TA 2012

Helping design and run lab experiments, grading, one-on-one help

OE 810 – Ocean Measurements Lab, Guest Lecturer 2012

A4.6 PROFESSIONAL OUTREACH ACTIVITIES

Technical Advisory Group US Shadow Committee for IEC TS 62600-2:2016 Marine energy - Wave, tidal and other water current converters - Part 2: Design requirements for marine energy systems.

Reviewer: Aquaculture Engineering 2017–present

Reviewer: Marine Energy Technology Symposium 2018

Fishermen's Forum. *Technical Strategies for Anchoring Floating Aquaculture Structures* 2019

North Hampton Middle School Buoy Project 2013-present

Designed curriculum with science and math teachers around the physics of buoys, culminating in students testing their models in the UNH wave tank. Included real-time, interactive internet broadcast of wave energy/aquaculture experiments.

College Success Foundation Higher Education Readiness Opportunity Program 2013

Designed and gave short, simple wave tank demonstrations and lessons on buoy dynamics to groups of at-risk, college-bound teenagers.

University of New Hampshire Engineering Camp 2013

Appendix 5 Cost of Metocean Study to Establish Extreme Current Speeds.

A budgetary estimate for quantifying the maximum expected currents at each net pen location as required by BAP was obtained from ASL Environmental Sciences Inc., of Victoria, B.C. The cost of this analysis for a single site—exclusive of airfare and lodging for the field technician—would be $18,284 (Table 11). That quote was extrapolated to estimate the cost of quantifying the maximum expected currents at each of seven net pen locations in three different geographical areas (Bellingham Channel, Hope Island, and Rich Passage). Since published literature[119] suggests currents in Port Angeles are below the 0.5 m/s speed allowed by the manufacturer, a current study in Port Angeles was not included in this estimate. To be conservative in this extrapolation, the following assumptions were used:

- All seven locations would be measured simultaneously.
- Time and materials required for management, equipment mobilization, and data processing would be the same as those required for a single deployment. (In reality, these costs will increase with the larger scope.)
- Instruments for a single geographical area (e.g. Bellingham Channel, Hope Island, or Rich Passage) would be deployed in a single day. Similarly, all instruments for a geographical area would be recovered in a single day.
- Equipment and operational costs would not increase for net pens in deeper locations.
- No professional liability insurance would be need.
- No weather days would be included.
- Cooke would supply a vessel and a field technician to assist ASL at no cost.
- Shipping instruments, flights, hotels, and meals were not included.

Using these conservative assumptions, Table 12 shows that quantifying the maximum expected currents at seven net pen locations would have cost a minimum of $77,954.

[119]Ebbesmeyer, C. C., et al. "Dynamics of Port Angeles Harbor and Approaches." Prepared for the MESA (Marine Ecosystems Analysis) Puget Sound Project (1979).

Table 11. Quote from ASL for quantifying maximum expected currents at a single net pen location.

Twenty and fifty year return currents at ~ 6 m and 16 m depth at the outer edge of a tidal channel in water depths of 25-30 m. For a client in Washington State.							
File:	**P1474**						
Date:	**February-28-2018**						
ASL Environmental Sciences Inc.							
All Prices in USD							
Item		**units**	**$/unit**	**#**	**cost ($)**	**Type**	**Date (MMM-YY)**
1	**Base**						
1.1	**Management**						
	Program Planning / Management / HSE / Personnel Mobilization						
	Rick [redacted]	day	875	1	875		
	Jerem[redacted]	day	607	1	607		
	Kea[redacted]	day	684	1	684		
	Communications (L.D. Telephone, fax, courier)				250		
	Handling on Direct Expenses		10%		25		
		Sub-Total Task 1.1			**2,441**	Cost Plus	Aug-19
1.2	**Mobilize Equipment**						
	Jerem[redacted]	day	607	1	607		
		Sub-Total Task 1.2			**607**	Cost Plus	Aug-19
1.3	**Equipment Lease and Consumables for 38 days (Assumes 30 day deployment, and 3 days transit to and from the field)**						
	TELEDYNE RDI 600 kHz WH Sentinel ADCP - 200 m	unit	2,480	1	2,480		
	Lease of mooring, releases and equipment for field operations	unit	2,558	1	2,558		
	40% Discount if ASL provides field and data services	unit	2,015	1	-2,015		
	Consumables (batteries)	unit	600	1	600		
	Consumables (mooring)	unit	750	1	750		
	Insurance	unit	4,201	1	4,201		
	Handling on Direct Expenses		10%		420		
		Sub-Total Task 1.3			**8,994**	Cost Plus	Aug-19
1.4	**Field Work (Trip 1 - Deployment)**						
	Travel and Field Time						
	Jerem[redacted]	day	607	3	1,821		
		Sub-Total Task 1.4			**1,821**	Cost Plus	Aug-19
1.6	**Field Work (Trip 2 - Recovery)**						
	Travel and Field Time						
	Jerem[redacted]	day	607	3	1,821		
		Sub-Total Task 1.6			**1,821**	Cost Plus	Aug-19
1.8	**Data Processing and a Brief Quality Report (Currents Measurements and the 20 and 50 year return inteval currents at 2 selected depths)**						
	Jerem[redacted]	day	607	3	1,821		
	Rick [redacted]	day	875	0.5	437		
	Kea[redacted]	day	684	0.5	342		
		Sub-Total Task 1.8			**2,600**	Cost Plus	Aug-19
			Total Task 1		**18,284**		
Notes							
1	All pricing is based on ASL fixed rates and estimates for third parties.						
2	Part of the program planning is to design an appropriate mooring for the site and application.						
	Details learned during this phase may impact the equipment which is required or the						
	consumables required to build the mooring.						
3	Assumes no professional liability insurance is needed. If needed, it is available.						
4	Number of days for lease and labour are estimates. Actual time will be charged.						
5	Number of days for field work are estimates only. Due to unforeseen events like weather delays, the actual time may be more.						
6	The lease cost of 2 single point current meters was ~ $1000 less than the lease cost of the ADCP which provides						
	measurements over the full water column. Use of an ADCP also allows currents which track the sea-surface to be obtained rather						
	than a fixed depth which a point current meter provides.						
7	If the client uses ASL to do the field work and data analysis, a 40% discount will be provided on the lease rates.						
8	If the client chooses to complete the work themselves and just lease the equipment,						
	an additional mobilization fee to prepare the equipment will be incurred.						
9	If the client chooses to lease the equipment and do the work themselves, they must sign a lease agreement						
	in which they agree to be responsible for damage or loss of the equipment. Insurance should be obtained for this scenario.						
10	Vessel costs have not been included. ASL can arrange a vessel if desired. Vessel costs as well as costs to						
	find the vessel and make arrangements will be passed on to the client.						
11	Pricing assumes the client has found an anchor locally which will satisfy the mooring requirements which are developed.						
12	Shipping to the site, flights, hotels and other third party costs associated with the field work have not been provided here.						
13	The use of one field tech assumes a competent field tech to assist with the field operations will be provided by the client.						
14	All third party expenses will be charged a handling fee.						

Table 12. Quote from ASL for quantifying maximum expected currents at seven net pen locations in three geographical areas. Inputs adjusted relative to the original quote are indicated in *underlined italics.*

ASL Environmental Sciences Inc.

All Prices in USD

Item		units	$/unit	#	cost ($)	Type
1	Base					
1.1	Management					
	Program Planning / Management / HSE / Personnel Mobilization					
	Managing Physical Oceanographer	day	875	1	875	
	Technician	day	607	1	607	
	Sr. Physical Oceanographer	day	684	1	684	
	Communications (L.D. Telephone, fax, courier)				250	
	Handling on Direct Expenses		10%		242	
		Sub-Total Task 1.1				$2,658
1.2	Mobilize Equipment					
	Technician	day	607	1	607	
		Sub-Total Task 1.2				$607
1.3	Equipment Lease and Consumables for 36 days (Assumes 30 day deployment, and 3 days transit to and from the field)					
	TELEDYNE RDI 600 kHz WH Sentinel ADCP - 200 m	unit	2,480	*<u>7</u>*	17,360	
	Lease of mooring, releases and equipment for field operations	unit	2,558	*<u>7</u>*	17,906	
	40% Discount if ASL provides field and data services	unit	-2,015	*<u>7</u>*	-14,105	
	Consumables (batteries)	unit	600	*<u>7</u>*	4,200	
	Consumables (mooring)	unit	750	*<u>7</u>*	5,250	
	Insurance	unit	4,201	*<u>7</u>*	29,407	
	Handling on Direct Expenses		10%		6,002	
		Sub-Total Task 1.3				$66,020
1.4	Field Work (Trip 1 - Deployment)					
	Travel and Field Time					
	Technician	day	607	*<u>5</u>*	3,035	
		Sub-Total Task 1.4				$3,035
1.5	Field Work (Trip 2 - Recovery)					
Travel and Field Time						
	Technician	day	607	*<u>5</u>*	3,035	
	Sub-Total Task 1.5					$3,035
1.6	Data Processing and a Brief Quality Report (Currents Measurements and the 20 and 50 year return interval currents at 2 selected depths)					
	Technician	day	607	3	1,821	
	Managing Physical Oceanographer	day	875	0.5	437	
	Sr. Physical Oceanographer	day	684	0.5	342	
		Sub-Total Task 1.6				$2,600
		Total Task 1				**$77,954**

ASL Environmental Sciences Inc.

All Prices in USD

Item	units		$/unit	#	cost ($)	
1	Base					
1.1	Management					
	Program Planning / Management / HSE / Personnel Mobilization					
	Managing Physical Oceanographer	day	875	1	875	
	Technician	day	607	1	607	
	Sr. Physical Oceanographer	day	684	1	684	
	Communications (L.D. Telephone, fax, courier)				250	
	Handling on Direct Expenses		10%		242	
		Sub-Total Task 1.1				$2658
1.2	Mobilize Equipment					
	Technician	day	607	1	607	
		Sub-Total Task 1.2				$607
1.3	Equipment Lease and Consumables for 36 days (Assumes 30 day deployment, and 3 days transit to and from the field)					
	TELEDYNE RDI 600 kHz WH Sentinel ADCP - 200 m	unit	2,480	8	19,840	
	Lease of mooring, releases and equipment for field operations	unit	2,558	8	20,464	
	40% Discount if ASL provides field and data services	unit	-2,015	8	-16,120	
	Consumables (batteries)	unit	600	8	4,800	
	Consumables (mooring)	unit	750	8	6,000	
	Insurance	unit	4,201	8	33,608	
	Handling on Direct Expenses		10%		6,859	
		Sub-Total Task 1.3				$75,451
1.4	Field Work (Trip 1 - Deployment)					
	Travel and Field Time					
	Technician	day	607	6	3,642	
		Sub-Total Task 1.4				$3,642
1.5	Field Work (Trip 2 - Recovery)					
Travel and Field Time						
	Technician	day	607	6	3,642	
	Sub-Total Task 1.5					$3,642
1.6	Data Processing and a Brief Quality Report (Currents Measurements and the 20 and 50 year return interval currents at 2 selected depths)					
	Technician	day	607	3	1,821	
	Managing Physical Oceanographer	day	875	0.5	437	
	Sr. Physical Oceanographer	day	684	0.5	342	
		Sub-Total Task 1.6				$2,600
		Total Task 1				**$88,606**

Appendix 6 Annual Cost of Inspecting Mooring Systems Deeper than 100 Feet.

Goals of Inspections:

- Confirm that anchor(s) are embedded properly
  - Anchors may not have been installed correctly
  - Storms can cause anchors to drag, possibly not re-embed
- Confirm that, to the extent visible, anchors are in good condition
  - No damage from debris, other lines dragging against anchors
  - No damage from scouring
- Confirm that anchor shackles are in good condition
- Confirm that chain on the seafloor shows limited corrosion or abrasion, especially at chain touchdown points
- Confirm that rope (when used) and thimbles are intact and not abraded.

A remote-operated vehicle (ROV) can be used to inspect anchors. These are self-propelled systems with a camera, connected to the surface through an umbilical wire. The operator at the surface drives the ROV along the mooring line to the anchor, making the same visual inspection that a diver would perform. Use of an ROV generally requires a support boat and an ROV team of at least two people.

Cooke Aquaculture Pacific fish farms are clustered in four distinct areas. Instead of requiring mobilization/demobilization work for each fish farm, these tasks can be combined into four tasks instead of eight.

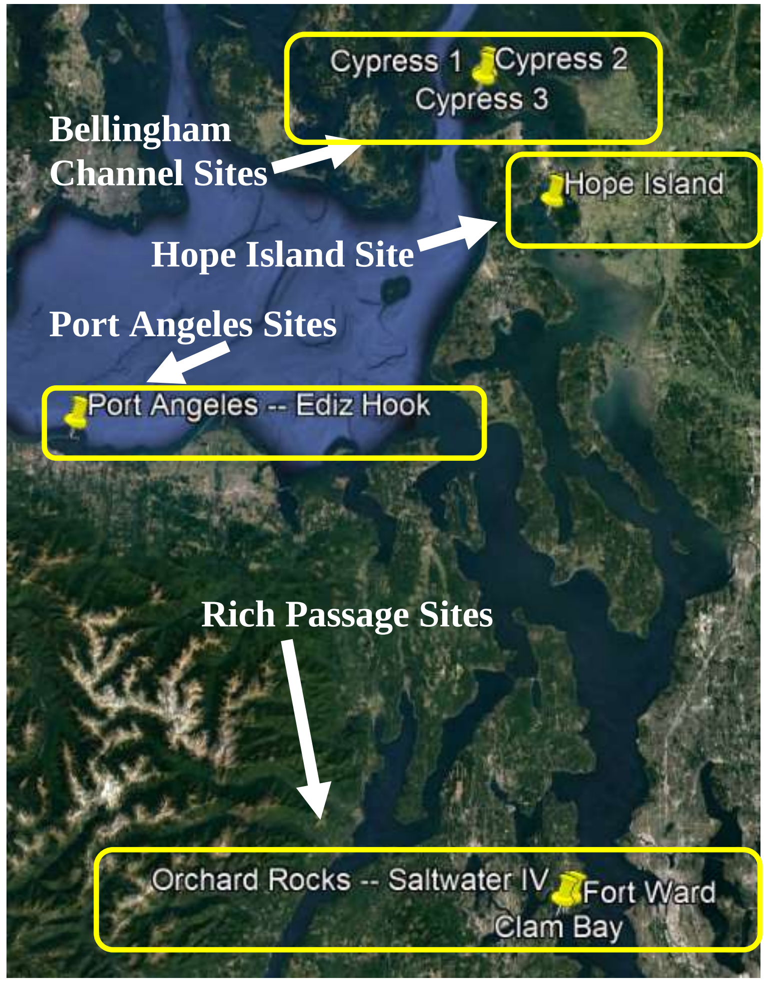

Figure 1. Locations of Cooke Aquaculture Pacific fish farms. Farms are clustered in four areas.

A6.1 Costs of ROV Inspections using Outside Contractors

The annual cost for hiring a contractor to inspect anchors deeper than 100 feet was estimated based on a quote by Collins Engineering[121] ("Collins") prior to their inspections with Mott MacDonald in late 2017. This budget estimated the time and cost to inspect moorings and structures at Hope Island, Port Angeles 1 and 2, Fort Ward, Orchard Rocks, and Cypress Island Site 1 and 3. Collins' estimates were based on the assumption that only three of these sites included anchors deeper than 100 feet[122]. (Clam Bay and Cypress Site 2 were not included. And Collins was apparently unaware at the time of providing the estimate that Orchard Rocks South and Cypress Site 1 had anchors deeper than 100 feet.) Collins estimated that the three sites with anchors deeper than 100 feet would require 6 days of ROV surveys. They also estimated that each of the seven sites would require one day of post-processing and report writing. Thus, it is assumed here that each site with anchors deeper than 100 feet required two days of ROV surveying and one day of post-processing and report writing. To be conservative, it was assumed that sites with less than 10 anchors deeper than 100 feet required only one day of ROV surveying and half a day of reporting.

[121] Subconsultant agreement between Mott MacDonald and Collins.pdf, Table 2.
[122] Subconsultant agreement between Mott MacDonald and Collins.pdf, Table 1.

Table 13. Cost of ROV Contracted Inspection Services per day as quoted by Collins Engineers, Inc.

Activity	Day Rate
Mobilization	-
ROV Survey Operations	$3,200
Reports	$3,700
Travel and lodging	(not included)

Assumptions in the following cost analyses are as follows:

- The number of anchors and depths for each fish farm were derived from an Excel workbook provided by Cooke Aquaculture Pacific.[123]
- The last mooring diagram created by Cooke shows 16 anchors at the Cypress 2 site.[124] Although the anchor depths were undocumented, Global Diving and Salvage[125] found at least one anchor deeper than 100 feet. For this analysis 15 anchors were assumed to be in shallow water (< 100 foot depth) and one anchor in deep water.
- Mooring diagrams from Cooke were reviewed for evidence of inspection or replacement of deep water mooring components. These Excel workbooks included some inspection dates and some dates of key maintenance or replacement activities. However, none of the materials reviewed suggested any inspection which would have offset the need for an ROV inspection at any of the sites for any of the years considered in this report.
- All values are in 2017 USD.
- This estimate does not include any of the following:
    - Explicit costs for mobilization including assembling, calibrating equipment, fueling, and transporting the ROV,
    - Weather days
    - Travel and lodging for contractors

Table 14 shows the annual costs Cooke would have incurred to comply with the mandated annual inspections of mooring components by contracting an ROV survey service annually between 2012 and 2016. In 2017, Mott MacDonald contracted with Collins Engineers to inspect all remaining net pens and moorings after the Cypress 2 collapse. Table 15 provides the costs Cooke would have expended to have the deep water moorings inspected. Similarly, Table 16 provides the costs to inspect the deep water moorings at Cypress 1 and 3 in 2018.

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[123] Kyl Wood, Cooke Aquaculture Pacific, “anchor depths.xlsx”, created 9/11/2018.
[124] COOKE_CWA_00018184.xlsx, updated 8/3/2017.
[125] COOKE_CWA_00047601-COOKE_CWA_00049032.pdf , Global Diving and Salvage, *Cypress Island Debris Recovery Project*.

Table 14. Costs avoided by not inspecting anchors deeper than 100 feet annually from 2012–2016

Mob. Group	Site	# Deep Anchors	ROV survey (Days)	Post-Proc and Reports (Days)	
1	Hope Island	0	0	0	
2	Cypress 1	5	1	0.5	
2	Cypress 2	1	1	0.5	
2	Cypress 3	10	2	1	
3	Port Angeles Main	23	2	1	
3	PA Secondary	13	2	1	
4	Clam Bay North	5	1	0.5	
4	Clam Bay South	10	2	1	
4	Orchard Rocks North		0	0	
4	Orchard Rocks South	3	1	1	
4	Fort Ward	0	0	0	
	Days		12 days	6.5 days	
	Rate per day		$3,200	$3,700	**Total**
	Cost		$38,400	$24,050	**$62,450**

Table 15. Costs avoided by not inspecting anchors deeper than 100 feet in 2017

Mob. Group	Site	# Deep Anchors	ROV survey (Days)	Post-Proc and Reports (Days)	
1	Port Angeles Main	23	2	1	
1	PA Secondary	13	2	1	
2	Clam Bay North	5	1	0.5	
2	Clam Bay South	10	2	1	
2	Orchard Rocks North		0	0	
2	Orchard Rocks South	3	1	1	
	Days		8 days	4.5 days	
	Rate per day		$3,200	$3,700	
	Cost		$25,600	$16,650	**$42,250**

Table 16. Costs avoided by not inspecting anchors deeper than 100 feet annually in 2018

Mob. Group	Site	# Deep Anchors	ROV survey (Days)	Post-Proc and Reports (Days)	
1	Cypress 1	5	1	0.5	
1	Cypress 3	10	2	1	
	Days		3 days	1.5 days	
	Rate per day		$3,200	$3,700	
	Cost		$9,600	$5,550	**$15,150**

A6.2 Costs for ROV Inspections using Cooke Aquaculture Pacific Staff

A6.2.1 Cost of Labor

ROV operators and boat support staff will be experienced, trusted employees. The US Bureau of Labor Statistics (BLS) does not offer information on pay rates for ROV operators. Based on skill levels and working environments, equivalent occupations are commercial divers and surveyors who work with sophisticated measuring equipment in the field. Averaging the 2017 hourly rates for these occupations in Washington State (Table 17) yields $32.14 per hour. According to the BLS[126] these rates would be unchanged during the following year.

Table 17. Labor Rates in Washington State

Occupation	2017 Mean Hourly Rate in Washington	Source
Commercial Divers	$25.80	https://www.bls.gov/oes/2017/may/oes499092.htm
Surveyor	$38.48	https://www.bls.gov/oes/current/oes171022.htm

[126]BLS, "Real average hourly earnings unchanged from June 2017 to June 2018," https://www.bls.gov/opub/ted/2018/real-average-hourly-earnings-unchanged-from-june-2017-to-june-2018.htm, July 17, 2018.

The BLS states that: "Wages and salaries averaged $23.85 per hour worked and accounted for 70.0 percent of these costs, while benefit costs averaged $10.20 and accounted for 30.0 percent."[127] Based on this, the total hourly rate for ROV operators and crew is $45.91 per hour.

An ROV dive team would consist of a boat driver and an ROV operator. As they would have equivalent skill levels, the hourly rate for labor on the ROV support boat would be $91.83. With the exception of documentation tasks, all activities are assumed to require the same two-person team, the boat and the ROV itself.

A6.2.2 Cost of Boat and ROV

An ideal support vessel for the ROV would be robust as it will be out in open water. It would include a partially enclosed space for the ROV control so that the operator can read the screen on a sunny day. The boat would be designed so that it is relatively simple to load and unload, with a relatively open arrangement to hold equipment, an enclosed cabin and a bow ramp for easy mobilization. Such a boat, e.g. a Munson 24-32 Sport, can cost up to $191,000[128]. However, for the sake of being conservative in the present analysis, a simple 17' Boston Whaler *Montauk* (2016) was assumed. Using the calculations in Table 18 a rate of $28.67/hour was obtained for the support boat.

There are a number of industrial quality, inspection class ROVs on the market. The device has to have bright underwater illumination, good maneuverability, and enough thrust to operate in moderate currents. The device has to be rugged and reliable to handle frequent use and handling in challenging wave and current conditions. As this is a precision device, maintenance and support services must be available domestically.

Table 18. Cost of ROV Support Boat

ROV Support Boat		
17' Boston Whaler MONTAUK[129] 170/CC (2016)	$28,667	List Price
Assuming 5 year depreciation	$5,733	per year
Assuming 400 hours/year	$14.33	per hour
Insurance, Docking		
50% of hourly rate	$7.17	
Maintenance		
50% of hourly rate	$7.17	
	$28.67	total per hour

Table 19 lists two ROV packages suitable for this application. The DTX2 package from DeepTrekker can operate up to 305 m (1000 ft.) deep. The DTX2 package includes cases and a

[127] BLS, "EMPLOYER COSTS FOR EMPLOYEE COMPENSATION –DECEMBER 2018," https://www.bls.gov/news.release/pdf/ecec.pdf, USDL-19-0449, March 19, 2019
[128] https://www.munsonboats.com/series24-MVCKAT.php. Retrieved 4/2/2019
[129] https://www.nadaguides.com/Boats/2016/Boston-Whaler-Inc/MONTAUK-170-CC_/32063531/Specs. Retrieved 4/2/2019

150 m (492 ft) tether. The SeaOtter-2 from JW Fishers can operate at a depth of 500 feet and includes a 250-foot tether. Both the DTX2 and the SeaOtter-2 have metal housings for durability.

Table 19. Cost of Remote-Operated Vehicles

Model: DeepTrekker DTX2 Package[130]			Model: JW Fishers SeaOtter-ROV[131]		
Includes umbilical, cases	$26,999	List	Includes umbilical, cases	$19,940	List
Assuming 5 year deprec.	$5,400	per yr	Assuming 5 year deprec.	$3,988	per yr
Assuming 400 hours/year	$13.50	per hr	Assuming 400 hours/year	$9.97	per hr
Insurance, Spare Parts			Insurance, Spare Parts		
50% of hourly rate	$6.75		50% of hourly rate	$4.99	
Maintenance and Service			Maintenance and Service		
50% of hourly rate	$6.75		50% of hourly rate	$4.99	
Total cost per hour	$27.00		Total cost per hour	$19.94	

ROVs require periodic maintenance and have a limited life. In this analysis it is assumed that the life of an industrial inspection ROV is 5 years. To be conservative, it was assumed that the ROV would be regularly used for other tasks and actively operated for 400 hours per year. The costs for insurance, spare parts and maintenance/service were assumed to equal the hourly costs of the device itself. Averaging the costs of the two representative ROV systems results in a cost of $23.47 per hour.

Table 20 is an estimate of the costs of using CAP staff and equipment to perform anchor and mooring inspections of anchors more than 100 feet deep. Two hours per site is allotted for perfunctory reporting of observations. Some factors not included in these estimates are:

- Staff training
- Staff land transportation
- Loss of equipment use due to maintenance and repair activities

In 2017, Mott MacDonald contracted with Collins Engineers to inspect all remaining net pens and moorings after the Cypress 2 collapse. Table 21 provides the costs Cooke would have expended to inspect the remaining deep water moorings. Similarly, Table 22 provides the costs to inspect the deep water moorings at Cypress 1 and 3 in 2018.

[130] DTX2 Package, Deep Trekker, https://www.deeptrekker.com/product/dtx2-rov/, retrieved 03/22/2019
[131] SeaOtter-2 ROVER- Underwater Video System, JW Fishers Mfg Inc., https://www.gsaadvantage.gov/advantage/catalog/product_detail.do?gsin=11000017496642, retrieved 03/22/2019.

Table 20. Estimated annual cost of ROV inspections using CAP staff, only anchors deeper than 100 feet from 2012–2016

Mob. Group	Site	# Deep Anchors	Mobilization/ Demobilization	Anchor Inspections (Days)	Anchor Inspections (Hours)	Transit to/ from site (hours)	Post-Proc. and Report
1	Hope Island	0		0	0	0	0
2	Cypress 1	5	12	1	8	2	2
2	Cypress 2	1		1	8	2	2
2	Cypress 3	10		2	16	4	2
3	Port Angeles Main	23	12	2	16	4	2
3	PA Secondary	13		2	16	4	2
4	Clam Bay North	5	12	1	8	2	2
4	Clam Bay South	10		2	16	4	2
4	Orchard Rocks North	0		0	0		
4	Orchard Rocks South	3		1	8	2	2
4	Fort Ward	0		0	0		
	Hours		36 hours	12 days	96 hours	24 hours	16 hours
	Cost		$5,183		$13,821	$3,455	$735

Total Annual Cost **$23,193**

Table 21. Estimated annual cost of ROV inspections using CAP staff, only anchors deeper than 100 feet in 2017.

Mob. Group	Site	# Deep Anchors	Mobilization/ Demobilization	Anchor Inspections (Days)	Anchor Inspections (Hours)	Transit to/ from site (hours)	Post-Proc. and Report
1	Port Angeles Main	23	12	2	16	4	2
1	PA Secondary	13		2	16	4	2
2	Clam Bay North	5	12	1	8	2	2
2	Clam Bay South	10		2	16	4	2
2	Orchard Rocks North			0	0		
2	Orchard Rocks South	3		1	8	2	2
	Hours		24 hours	8 days	64 hours	16 hours	10 hours
	Cost		$3,455		$9,214	$2,303	$459

Total Annual Cost **$15,432**

Table 22. Estimated annual cost of ROV inspections using CAP staff, only anchors deeper than 100 feet in 2018.

Mob. Group	Site	# Deep Anchors	Mobilization/ Demobilization	Anchor Inspections (Days)	Anchor Inspections (Hours)	Transit to/ from site (hours)	Post-Proc. and Report
1	Cypress 1	5	12	1	8	2	2
1	Cypress 3	10		2	16	4	2
	Hours		12 hours	3 days	24 hours	6 hours	4 hours
	Cost		$1,728		$3,455	$864	$184

Total Annual Cost **$6,230**

Appendix 7 Cost of Upgrading Net Pen Systems

Cost estimates for 25m-by-25m square steel cages designed for high-energy sites were obtained from the AKVA group. According to the personal communication with the AKVA group, their WaveMaster EX-2 cage system is design to withstand currents up to at least 190 cm/sec. This is the highest allowable current speed of any steel cage known to the author. This estimate gives the cost per cage (i.e. one 25m-by-25m bay in a net pen system) at $130,000 CAD. Using the CAD to USD exchange rate for Jan. 1, 2013[132], this is equivalent to $130,000 in 2013 USD. The costs of stock nets, predator nets, and aviary nets were not included in this analysis because Cooke incurred these costs while operating its cages. The cost of the purchasing and installing a mooring system similar to those in use by Cooke between 2012 and 2017 was taken to be $150,000[133]. This cost was multiplied by 20% to account for the increased capacity recommended by DSA[134]. Summing these costs results in an estimated cost of $310,000 per cage.

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[132] https://www.xe.com/currencycharts/?from=USD&to=CAD&view=10Y. Accessed 6/3/2019

[133] http://www.soyaquaalliance.com/wp-content/uploads/2014/02/07-Alan-Cook-2014-Finance-Roundtable-Salmon-Netpen-Production.pdf. Accessed 6/3/2019

[134] DSA/COOKE_CWA_00241926.pdf

Product: Wavemaster EX 2 Cage System	Wavemaster 25m x 25 m - EX2 Cage system in a 6 x 2 Configuration			AKVA GROUP
Date: 30-05-2019	Page: 2 of 6	Rev: Rev. 1.0	Drawn up by: BB	

Maine Marine Composites

Attn. Mr. Richard Akers

Below is our budget offer of Wavemaster EX 2 Cages

1. Description: 12 cages 25x25 meter EX-2 Design

Product Description

Number of sets	: 1 (one) set.
Number of Cages	: 12 (eight) units. 6 by 2 arrangement.
Dimensions	: 25 by 25 meters.
Main Beam Dimensions	: 200 x 70 x 6 mm
Main Walkways	: 2.3 m wide.
Perimeter Walkways	: 2.0 m wide.
Head End Walkways	: 2.0 m wide.
Stabilizers	: Included are 04 pcs of stabilizing (flappers) for leading edges of pen system (prevents twisting)
Hinges	: 2 hinge points with 1¾" inch stainless steel hinge pins and Technygen plastic bushing.
Decking	: 25 x 5mm Steel Grating.
Floats	: Super Jumbo Rotational Molded Polyethylene foam filled floats.
Handrails	: 1¼" inside perimeter steel handrails – 1 meter height with welded net hook pointed up and down.
Corrosion Protection	: Hot Dipped Galvanizing.

2. Pricing- Wavemaster Steel Cage System

(12) 25 m x 25 m Wavemaster cages as indicated in above section 1.0 Description.

COMPONENT	QTY		PRICE (CAD)
STEEL	1	$	1.070.000
FLOATS (CANADA)	1	$	300.000
STEEL FREIGHT (CHILE)	1	$	130.000
FLOATS FREIGHT (VANCOUVER)	1	$	60.000
TOTAL	**12**	**$**	**1.560.000**
TOTAL PER CAGE		**$**	**130.000**

Components are CIF Vancouver, BC.

Figure 2. Budget Estimate for a WaveMaster EX-2.

The $2,700,000 that Cooke expended in purchasing and installing new cages at Clam Bay was subtracted from the total cost of acquiring more robust cages, since these costs would have been displaced by the cost of the more robust cage system.

Table 23. Costs to Upgrade Net Pens to More Robust Technology

Upgrade the cage system at Cypress Island #1 (8 cages)	$2,480,000	One time cost. Annual opportunities between Sept. 14 2012 and the present
Upgrade the cage system at Cypress Island #2 (10-cages)	$3,100,000	One time cost. Annual opportunities between Sept. 14 2012 and the present
Upgrade the cage system at Cypress Island #3 (12 cages)	$3,720,000	One time cost. Annual opportunities between Sept. 14 2012 and the present
Upgrade the cage system at Hope Island (10 cages)	$3,100,000	One time cost. Annual opportunities between Sept. 14 2012 and the present
Upgrade the cage system at Fort Ward (12 cages)	$3,720,000	One time cost. Annual opportunities between Sept. 14 2012 and the present
Upgrade the cage system at Orchard Rocks (20 cages)	$6,200,000	One time cost. Annual opportunities between Sept. 14 2012 and the present
Upgrade the 12 cage system at Clam Bay	$3,720,000	One time cost. Annual opportunities between Sept. 14 2012 and the present
Select a more robust 10 cage system at Clam Bay than the one installed in 2013/14	$400,000	Jan. 1 2014. Difference between actual cost and estimate of cost for a sufficiently robust system

APPENDIX 7 List of Records Considered

In addition to drawing upon his knowledge and expertise, and a general review of relevant literature in the field, Dr. Dewhurst considered the records listed below or portions thereof in forming the opinions expressed in his report. Pursuant to the parties' Rule 26(a) agreement, the Conservancy will produce the expert's file within two weeks of disclosure of this report or one week before the expert's deposition, whichever is sooner.

- Cooke NPDES Permits, fact sheets, and permit applications
- Cooke's Pollution Prevention Plans, Fish Escape Prevention Plans, Plans of Operations, Spill Prevention, Control, and Response Plans, and Annual Accidental Fish Release Reports
- Portions of reports prepared by Mott MacDonald for each of Cooke's net pens, and records cited therein, and related invoices and contracts
- The Washington agency report regarding the collapse, dated January 30, 2018, and records cited therein
- Notes from Washington agency interviews of Cooke employees and contractors taken after the August 2017 Cypress Site 2 collapse
- Cooke's response to the January 30, 2018 Washington agency report regarding the collapse and records cited therein
- Global Diving and Salvage Report on the Cypress Island Debris Recovery Project, dated December 2017-February 2018, and related invoice
- Photos and videos of the Cypress Site 2 structure after the collapse
- Communications between Cooke and Washington agencies since the collapse, including records related to administrative enforcement and lease termination
- Manufacturer specifications for cages installed at the net pen sites
- Records related to Cooke's Best Aquaculture Practice certification
- Mooring diagrams for the net pens
- Discovery requests and responses in the litigation
- Records related to the July 2017 incident at Cypress Site 2
- Daily Logs for the net pens
- Spreadsheet related to Cooke's 2018 anchor inspections
- Deposition testimony of Jim Parsons, Cooke's designated Federal Rule of Civil Procedure 30(b)(6) witness
- Records exchanged between Dynamic Systems Analysis, Ltd. and Cooke, including but not limited to proposals, bids, emails, and reports
- Surveys conducted of the net pens, including pontoon surveys and Risk Management Surveys
- Cooke's briefing in this litigation
- Cooke Management Meeting Notes
- Norwegian Standard 9415:E:2009, *Marine fish farms, Requirements for site survey, risk analyses, design, dimensioning, production, installation and operation*
- The Washington Fish Growers Association Code of Conduct for Saltwater Salmon Net-Pen

Operations (Fall 2002)

- Akers, R. Fatigue Design Methodologies Applicable to Complex Fixed and Floating offshore Wind Turbines, TAP-758, Bureau of Safety and Environmental Enforcement, p. 68. Contract E13PC00019, 2015. https://www.bsee.gov/sites/bsee.gov/files/tap-technical-assessment-program//758aa.pdf, downloaded 3/26/2019
- Ebbesmeyer, C. C., et al. "Dynamics of Port Angeles Harbor and Approaches." Prepared for the MESA (Marine Ecosystems Analysis) Puget Sound Project (1979)
- Quotes from ASL for quantifying maximum expected currents at net pen locations
- BLS, "Real average hourly earnings unchanged from June 2017 to June 2018," https://www.bls.gov/opub/ted/2018/real-average-hourly-earnings-unchanged-from-june-2017-to-june-2018.htm, July 17, 2018
- BLS, "EMPLOYER COSTS FOR EMPLOYEE COMPENSATION –DECEMBER 2018," https://www.bls.gov/news.release/pdf/ecec.pdf, USDL-19-0449, March 19, 2019
- Munson, 24-32 Sport, https://www.munsonboats.com/series24-MVCKAT.php. Retrieved 4/2/2019
- NADA Guides, 2016 Boston Whaler Inc Montauk 170/CC(*) Specs, https://www.nadaguides.com/Boats/2016/Boston-Whaler-Inc/MONTAUK-170-CC_/32063531/Specs. Retrieved 4/2/2019
- DTX2 Package, Deep Trekker, https://www.deeptrekker.com/product/dtx2-rov/, retrieved 03/22/2019
- SeaOtter-2 ROVER- Underwater Video System, JW Fishers Mfg Inc., https://www.gsaadvantage.gov/advantage/catalog/product_detail.do?gsin=11000017496642, retrieved 03/22/2019.
- https://www.xe.com/currencycharts/?from=USD&to=CAD&view=10Y. Accessed 6/3/2019
- http://www.soyaquaalliance.com/wp-content/uploads/2014/02/07-Alan-Cook-2014-Finance-Roundtable-Salmon-Netpen-Production.pdf. Accessed 6/3/2019
- Records produced by Cooke in this litigation related to the costs of purchasing, replacing, and/or maintaining net pens and parts
- Current data and related files from Cooke current study in late 2017/early 2018

EXHIBIT 2

In the Matter Of:

Wild Fish Conservancy vs Cooke Aquaculture Pacific, LLC

TOBIAS DEWHURST

July 18, 2019

Gaige & Feliccitti, LLC

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UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF WASHINGTON
AT SEATTLE

WILD FISH CONSERVANCY,	)	
	)	
Plaintiff,	)	
	)	Case No.
vs.	)	2:17-cv-01708-JCC
	)	
COOKE AQUACULTURE	)	
PACIFIC, LLC,	)	
	)	
Defendant.	)	

DEPOSITION OF TOBIAS DEWHURST, Ph.D, taken pursuant to notice before Beth Gaige, RPR, a Notary Public in and for the State of Maine, at the offices of Gaige & Feliccitti, LLC, Norman Hanson & DeTroy, LLC, Two Canal Plaza, Portland, Maine, on July 18, 2019, commencing at 10:47 a.m.

GAIGE & FELICCITTI, LLC
205 Woodford Street
Portland, Maine 04103
(207)854-5296
scheduling@gandfreporting.com

A P P E A R A N C E S

FOR THE PLAINTIFF,

KEVIN CASSIDY, ESQ.
Earthrise Law Center
Lewis & Clark Law School
10015 S.W. Terwilliger Blvd.
Portland, Oregon 97219-7799
Phone: 781.659.1696
E-mail: Cassidy@lclark.edu

FOR THE DEFENDANTS,

(Via Videoconference)
DOUGLAS J. STEDING, ESQ.
Northwest Resource Law PLLC
101 Yesler Way, Suite 205
Seattle, WA 98104
Phone: 206.971.1564
E-mail: Dsteding@nwresourcelaw.com

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WITNESS: TOBIAS DEWHURST

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STIPULATION

(It is hereby agreed by and between the parties that signature is not waived.)

- - - - - - - - - -

TOBIAS DEWHURST, Ph.D., having been duly sworn by the Notary Public, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. STEDING:

Q. Good morning, Dr. Dewhurst. My name is Doug Steding. I represent the defendant Cooke Aquaculture Pacific in this matter. And with me in the room is Chris Wion, trial counsel from Summit Law. He will be listening in on the deposition today.

I -- just as a preliminary matter we shipped over a number of binders, and it's a binder set that is labelled one through four.

Do you have those binders with you?

A. Yes.

Q. Okay. The way we are going to work exhibits, it would probably be useful for you to have binder number one, which is titled Tobais Dewhurst - Supplemental WFC Expert, Docs Cited 1 thru 44, and it's got a sticker on it that

says Binder #1.
That is what is in front of you?
A. Correct.
Q. Okay. If you could open that and go to the first tab. And NOD and SDT, which is notice of deposition and subpoena.
Could you remove that document and hand it to the court reporter and label it as Exhibit 1, please.
(Off-the-record colloquy.)
(Deposition Exhibit No. 1 was marked for identification.)
MR. CASSIDY: Can I ask -- so before he starts to put this back in the binder, I mean this is going to be an exhibit so the court reporter will --
MR. STEDING: It is.
MR. CASSIDY: So he doesn't have to replace it in the binder right now.
MR. STEDING: That's correct.
MR. CASSIDY: Yeah.
MR. STEDING: I think it will be useful to -- to -- as exhibits get numbered they stay out of the binder.
MR. CASSIDY: Yeah.

MR. STEDING: Thank you, Kevin.
BY MR. STEDING:
Q. So, Dr. Dewhurst, you have been handed what's been labeled as Exhibit 1, a notice of deposition of yourself.
Have you reviewed this document?
A. I don't believe so, no.
Q. Okay. Did counsel provide you with this document?
A. Not that I recall.
Q. Okay. You have been asked to testify in the Wild Fish Conservancy v. Cooke Aquaculture Pacific matter, which is referenced on the first page of Exhibit 1.
Are you prepared today to testify in that matter?
A. I am.
Q. Okay. Go ahead and -- that same binder there is a tab called Supplemental Report. If you could remove from that binder the supplemental report and hand it to the court reporter and have her label it Exhibit 2.
(Deposition Exhibit No. 2 was marked for identification.)
Q. You have been handed what has been labelled as

Exhibit 2, entitled Expert Report of Dr. Tobias Dewhurst Wild Fish Conservancy v. Cooke Aquaculture Pacific, LLC, dated June 5, 2019.

I would just like you to take a minute and go through this document and let me know if it is a complete copy of the expert report that you have prepared in this matter.

A. It looks to be a complete copy of my report.

Q. Okay. You have been retained by Wild Fish Conservancy as an expert -- a testifying expert in this matter.

What is the scope of your engagement with respect to this litigation?

A. My scope was threefold. First of all, my job was to provide opinions on whether the catastrophic failure of Cooke's Cypress 2 net pen in August 2017 is attributable in part to Cooke's failure to identify and implement appropriate technology and best, slash, appropriate industry standards and practices.

The second part of my scope is to provide opinions on whether Cooke's operation and maintenance of its eight net pens in Puget Sound conformed to and complied with the NPDES

permit requirements, including its pollution prevention plan and its fish release prevention and monitoring plan.

And, thirdly, to identify actions or technology Cooke could have implemented, or could implement in the future, to comply with its permits and provide cost estimates for those actions or technology.

Q. Okay. I believe at page 40 of your report, labelled Appendix 4, is your CV. Go ahead and turn to that.

Is this an accurate representation of your relevant experience as an expert testifying in this case?

A. Yes, it is.

Q. And explain to me -- let's start with your experience.

You received a Bachelor of Science in mechanical engineering from Cedarville University in 2009?

A. Correct.

Q. And briefly give me a sense of the coursework that was involved in obtaining that Bachelor of Science.

A. The coursework associated with a Bachelor of

Science in mechanical engineering includes subjects like mechanics, statics, dynamics, fluids, thermal and heat transfer, thermal dynamics, advanced dynamics in my particular case, and -- and as well as design projects.

Q. Okay. And then you went on to receive a Masters of Science in ocean engineering in May 2013 from the University of New Hampshire and a Doctor of Philosophy in December 2016 from the same university. Is that correct?

A. Correct.

Q. And did you do coursework associated with that Masters and Ph.D. research?

A. I did.

Q. Give me a sense of the types of courses that you took associated with that, with that education.

A. Okay. Some samples are ocean measurements, waves and tides, finite elements analysis, advanced finite elements analysis to be specific, ocean modeling, and forgive me if I forget the exact names.

There were independent study courses, such as floating platforms design, partial differential equations, viscous flow,

turbulence, near shore waves, time series analysis.

I can keep going if you would like. Those are the ones that come to mind.

Q. Okay. And your dissertation was on the Dynamics of a Submersible Mussel Raft System.

Can you explain to me in layperson's terms what that dissertation topic entailed?

A. Okay. My job was to characterize how a certain aquaculture raft structure responded to waves and currents. In this particular case, it was a raft for growing mussels in the ocean.

Mussels in Maine are often grown on ropes suspended from rafts, but the problem with the existing technology is that the rafts tend to get destroyed by storms if you put them out in an exposed ocean environment.

So specifically I was investigating the loads and motions in a submersible mussel raft system so that raft could be ballasted with seawater so that most of the raft was below the surface of the ocean and -- and my job was to, first of all, do wave-takes studies of a scaled model of that system. Second, to

numerically model the system and do the engineering analysis of the mechanics and dynamics of that system. And, third, we go to the physical site of the raft and install instrumentation on the aquaculture system to monitor the loads and motions and the current speeds and wave environment which it was subjected to, and then validate my engineering analysis using that field data.

Q. Okay. And can you describe generally -- you mentioned that mussels were on lines.

Can you generally describe the configuration of a mussel raft with a little bit more detail, please?

A. Sure. So this particular raft is square. It consists of steel and high-density polyethylene. The mussel ropes are vertical, 45-foot ropes spaced about every two feet hanging down from that raft. They are surrounded by anti-predatory nets, and -- and you have anywhere from 350 to 500 ropes supporting these mussels all suspended from the square raft, which is either at the surface or below the sea surface.

Q. And you mentioned that part of your work was

related to assessing the loads on the raft structure.
How do you do that?
A. Two ways. First of all -- three ways. The first was to build a scaled physical model of a representative raft system, and that I tested in a wave tank with -- with a load cell attached. A load cell measures the force in the line.
The second way was to use a dynamic finite element model, what I sometimes call a hydro, slash, structural model, and in that approach -- and this is what we do in the aquaculture industry for many of these systems -- I break down all the components of the raft and the mooring system, including the nets, the buoys, the lines and, if applicable, the biomass, into small finite elements. And you find the forces on those -- each of those small elements as a function of the incident, relative fluid velocity and acceleration at each time step. That gives you a time domain model to stimulate the loads and the motions in your aquaculture system.
Q. You mentioned there was a third way?

A. The third way was to actually physically measure the loads on the real world prototype, the full scale system.
To do that I first deployed what is called an Acoustic Doppler Current Profiler, an ADCP. That measures the water velocities throughout the water column, from the bottom of the ocean to the top, at a single location near the raft. That particular instrument also measured the wave time series from which I could calculate the statistics of the sea state.
And then on the raft itself I installed two instruments. There is an Inertial Measurement Unit, an IMU. That measures the motions of the raft in 6 degrees of freedom. And the second type of instrument on the raft was a load cell. Some people call them tension gauges. Those replaced the last few feet of the mooring lines. In my case I had two of them placed on the seaward, two mooring lines, and they physically measure the mooring loads that the raft experiences.
Q. Okay. Let's talk about the dynamic model in a little bit more detail.

You mentioned that what goes into the dynamic model is a consideration of nets, buoys, lines, and moorings. Is that -- is that correct?
A. Those are some of the considerations, yes. Also sometimes you have to account for the biomass itself. In my case, the mussel ropes, and, of course, you have to prescribe the fluid flow field, the ways of the currents.
Q. So with respect to mussel ropes in particular, does the diameter of the rope matter?
A. It does.
Q. What about the length of the rope?
A. Definitely.
Q. What about the density of the ropes across the facility?
A. Yes, that's represented in the model.
Q. And then you mentioned biomass.
And with respect to mussels, is that increasing over time as the mussels are growing?
A. Yes, it is.
Q. And why are those factors important in that dynamic model?
A. My goal with the model is to make the -- make

it reflect reality in relation to the important physics. The loads and motions in an aquaculture system are primarily due to, first of all, fluid drag; second, fluid inertia; third, the inertia of the structure itself because it's a dynamic system; fourth, the internal forces of the structure. You need to know how each component is -- is affecting every other component. And that list is not in a particular order, but those are four reasons why all of those factors matter.

Q. So if you lack information say on the density of the mussel lines across the raft or the thickness of the rope or the length of the rope or the biomass, any one of those factors, then you are unable to accurately estimate the load on the system; is that correct?

MR. CASSIDY: I am going to object to the form of the question.

But you can answer.

THE WITNESS: Okay.

A. There are always tradeoffs between -- between certainty and feasibility. Obviously we can't describe the full system in perfect detail.

We make the best approximations that we can as engineers.
BY MR. STEDING:
Q. So what types of approximations will you make there --
MR. CASSIDY: Object to the form of the question.
Q. -- assuming you -- let me rephrase that.
BY MR. STEDING:
Q. If you lack information on biomass, what type of approximation would be made to make an accurate estimate of load on the system?
MR. CASSIDY: Object to the form.
But you answer.
A. First of all, I would try to -- try to do my best to get that information. If I do have to make assumptions, it depends on the purpose of my analysis. I'll give you two different potential purposes of the work that I do.
One potential purpose is to validate a numerical model. In that case, I make the best approximation, the best guess for any data which I can't obtain. So in that particular case my first step was to first physically observe the -- the mussel lines

when I visited the site.

The second was to talk to the farmers and -- and get their best estimate of the number of mussel ropes, for example. Because in that -- again, in this example the purpose is to validate a numerical model, in which case we want it to be as close to the physical system as possible.

The second alternative, which is often the case for our aquaculture clients, is that the purpose of my engineering analysis is to ensure the structural integrity of an aquaculture system. In that case, the -- we don't prescribe, for example, the amount of biomass that's on the farm at one particular time, instead we design it for a maximum allowable amount of biomass. And we give that specification to the client and make sure that they are not going to exceed that. Because if they do exceed that, there is the potential that the loads on the system could exceed the loads which -- for which the components were designed.

Q. One of the other variables that we talked about is the thickness of the mussel raft

lines.
What if you don't know something about the mussel raft thickness, how do you account for that?
A. Could you clarify what lines you mean?
Q. **Apologizes. The lines that the mussels are growing on that -- you mentioned 45 feet down into the water. If you don't know the -- you mentioned that the diameter of the lines goes into your calculation of loads.**
If you do not know the diameter of the lines, how did you account for that in calculating a load?
A. If the purpose is to validate a numerical model and if I did not know the density of those lines, I would put some large disclaimers on my validation process and I would figure out how to obtain that information.
If the purpose was to design a system for an aquaculture client, I would ask the clients what they are aiming for in terms of a maximum mussel rope diameter. And, by the way, when we talk at the mussel rope diameter, we are talking about the -- the diameter including

the mussels themselves. And I would use the client-provided maximum diameter in my analysis, and I would size components based off of that analysis.

And then I would tell the clients that that was the maximum allowable mussel rope diameter and that they should not exceed that. Because if they do, they are at risk of structural failure.

Q. Okay. The same question with respect to what if you do not know the length of the rope for purposes of your modeling analysis?

A. Similarly, that's a somewhat important factor. So I would, first of all, try to make sure I have that information and go take physical measurements. If I -- if I don't know it and I can't know it, then it depends on the purpose of my analysis.

If I am validating a model and trying to get as close as possible, I will take my best guess based on whatever information I do have about the system. If I am specifying a system for a client and designing it, then I would ask them what their maximum desirable mussel rope length would be, and then I would tell

them not to exceed that in operations because if they did then they would be at risk of structural failure.

Q. Okay. And so to wrap up, in all such instances when you lack information about variables, it is prudent to go try to gather that information empirically, directly, from measurements or specifications or otherwise; is that correct?

MR. CASSIDY: Just object to the form the question.

A. As an engineer, we like to have as much information as possible as -- and in reality that's as much information as feasible, so generally there's a cost benefit analysis to -- to how much data we can collect.

BY MR. STEDING:

Q. And how often -- since your Ph.D. dissertation, how often have you done work on mussel rafts in a professional capacity?

A. Somewhat continuously since my Ph.D. I have been working on them probably about two of the three years that I have been -- since my Ph.D.

Q. And have you done anything for commercial clients on mussel rafts like what you

described previously in terms of dynamic modeling of the systems?
A. Yes.
Q. Have you done environment compliance work like advising clients on compliance with permits for mussel rafts as part of your professional career?
A. My work relates to environmental compliance. That is not my main -- my main job.
Q. Do clients present you with copies of their applicable permits and say, hey, Dr. Dewhurst, can you tell me what this permit means and how I can comply with it?
A. Sometimes. Often they'll come with either requirements or requests from the permitting agency, and they will ask me to redesign the system or analyze the system to fit within those requirements or requests.
Q. And educate me. I assume these are clients in Maine?
A. Our clients are around the country, occasionally outside of the country but mostly in the U.S.
Q. And can you give me an understanding of the -- you mentioned that clients give you

requirements from agencies.
What kinds of requirements?
A. A common example is that the Army Corp of Engineers would require that the system be designed for a 20-year storm or -- or in certain cases a 100-year storm. So my job then is to analyze the prescribed aquaculture farm system in the 100 storm or 20-year storm conditions and then size the components, the anchors, the mooring lines, the buoys if necessary, to survive those conditions.
Q. And is this to be consistent or in compliant with Army Corp of Engineers Rivers and Harbors Act permits?
A. I don't know the --
Q. Are you familiar with that term?
A. Sorry to cut you off.
Q. Or are you familiar --
A. No, I don't whether it's under the Rivers and Harbors Act.
Q. Do you know if it's under the Clean Water Act?
A. I don't know off the top of my head, no.
Q. Okay. So you don't know the types of permits that they are trying to be compliant with?
A. That's right; it varies.

In the State of Maine, the Department of Marine Resources is the interface with the clients and it's the Department of Marine Resources that passes the permit on to the Army Corp of Engineers. So often the interface with the client is consolidated. So I don't -- I often don't know which acts a certain agency request relates to.

Q. Okay. And do you do work on net pens for the finfish aquaculture industry?

A. Primarily we do shellfish and also other aquaculture applications. We do some analysis of finfish, but it's not our main source of clients.

Q. By some analysis, how many analyses of finfish aquaculture facilities have you performed in your professional career?

A. One since -- since receiving any Ph.D., one during my Ph.D., that was not related to my dissertation.

Q. And where was that facility?

A. It didn't end up getting built.

Q. It was not an existing facility?

A. No, it was a concept study.

Q. What kind of concept study?

A. We were looking at the mooring loads in a multi-cage finfish system.

Q. Describe what do you mean by multi-cage finfish system.

A. So often in -- in the ocean we use circular net pens which are connected to a mooring grid, so you have multiple net pins connected to the same mooring grid.

Q. These are the circular plastic pens that are commonly used on the east coast of North America?

A. I wouldn't say they're common. Well, sure. Sure.

Q. And have you ever performed professional work on assessing the suitability of siting such facilities?

A. For finfish aquaculture?

Q. For finfish aquaculture, yes.

A. No.

Q. Have you performed inspections of such facilities?

A. No.

Q. Have you ever performed inspections of moorings of such facilities?

A. Not for finfish aquaculture, no.

Q. Have you ever advised clients on inspecting finfish aquaculture moorings?
A. No.
Q. Have you ever worked on steel cage systems like the ones that are involved in this litigation?
A. To clarify, the cages aren't made of steel in this particular application. You're talking about the structural components of the raft, correct.
Q. That's correct, the structural components of the raft, as opposed to the plastic circle cages we were just talking about.
A. So in that application the structure, the steel and high-density polyethylene structures, are similar to the mussel rafts we work with here on the east coast. So that is an example of a steel and HDPE raft.
Q. But you have not worked on a finfish aquaculture steel and HDPE raft; is that correct?
A. Correct. Yes, that is correct.
Q. You have never done, in your professional or academic career, modeling on a steel or an HDPE finfish aquaculture or raft system; is

that correct?
A. Correct.
Q. Have you ever done any professional work on aquaculture facilities on the west coast of North America?
A. Yes.
Q. Where?
A. So we have non-disclosure agreements with our -- with our customers, in particular because -- well, for many reasons. So I can't disclose the -- things like the locations of farms or the type of farms.
Q. Have you ever done any work on finfish aquaculture systems in Washington state?
A. No, not prior to this case.
Q. Have you ever done any professional work on modeling of aquaculture systems in Puget Sound?
A. No, I have not.
Q. Have you ever done any finfish aquaculture professional work in British Columbia?
A. No, I have not.
Q. Have you ever done any professional finfish aquaculture work in Chile?
A. I have not, and there are also -- if I --

there are many, many places in the world where I have not done many types of aquaculture analysis.

Q. **Understood. I'm just asking about specifics right now, but thank you for that clarification.**

Okay. Let's go to Exhibit 2, and I would like to go to page six of your report, Section 2.2. And that states Qualifications and Materials Reviewed and take a minute to review that first paragraph.

A. (Witness complying). I have reviewed it.

Q. **Okay. The first sentence you state that you are -- you prepared this report in the capacity of an expert familiar with the engineering of marine aquaculture structures and the technologies and practices needed to maintain such structures so as to prevent partial or catastrophic failures and other causes of pollution, including fish releases.**

Just so that I am clear, what is the work that you have done with respect to preventing fish releases?

A. So the work that I have done is the engineering of marine aquaculture structures

and the technologies and practices needed to maintain such structures so as to prevent partial or catastrophic failures and other causes of pollution. Those causes of pollution can include fish releases, for example, if a fish cage is destroyed and the fish escape.

Q. And you mentioned earlier that you have done work on one hypothetical polar circle cage, the plastic HDPE cage.

Is that what you are referring to? Is that the work that you are referring to as being familiar with engineering of marine structures to prevent partial or catastrophic failures and other causes of pollution, including fish releases?

A. No, I'm referring to all of my aquaculture engineering work, as the engineering of marine aquaculture structures and technologies and practices needed to maintain such structures to prevent partial or catastrophic failures and other causes of pollution. So those partial of -- so the engineering is related to designing it to avoid partial or catastrophic failures. When you have a partial or

catastrophic failure, that results in negative consequences; for example, in the finfish industry that results in fish releases.

Q. I want to -- let me get very specific. I would like you to identify, without disclosing clients or locations, the specific instances where you have advised clients on preventing fish releases.

A. I am not claiming to have advised clients on preventing fish releases. My work is doing the engineering to prevent catastrophic or partial failures. And those --

Q. Did you write that?

A. I did.

Q. Can fish be released from mussel rafts?

MR. CASSIDY: Objection.

A. Mussel farmers are certainly not concerned with releasing fish from their rafts.

BY MR. STEDING:

Q. Are mussels considered a pollutant?

A. That is a great question and in certain cases yes.

Q. In which cases?

A. In cases when you are talking to people who -- who view any release of aquaculture gear or

biomass as pollutants.
Q. So the gear, forgive me. I'm talking about the mussel itself.
Is that considered a pollutant?
A. Yes. I think any -- I think certain --
MR. CASSIDY: I'm going to object to the form of the question.
But go ahead.
A. I think pollutants and -- and this is not written to be a technical definition of pollutant, but generally people are concerned with any gear or biomass that's released from a site and ends up in the ocean.
BY MR. STEDING:
Q. The end of the second paragraph on Qualifications and Materials Reviewed, the last sentence, the author reserves the right to update Appendix 7 as new facts and data become available, either through discovery or otherwise.
Have any new facts or data become available since -- since the preparation of this report?
A. There are certainly documents that I have not reviewed. I don't believe that I have

thoroughly reviewed any new facts or data, but I have been made aware of -- of some facts and data that I hadn't -- had not seen prior to this report.

Q. What facts and data have you been made aware of?

A. This won't be a comprehensive list. Recently I was made aware of some work by a Dr. Jack Rensel regarding current speeds at the Cooke sites in Washington.

Q. And does that current work change the opinions that are presented in your report?

A. No, it does not.

Q. And why not?

A. Do you have a copy of that document?

Q. I do not.

A. Okay. I am not prepared to discuss it in detail because I haven't reviewed it thoroughly. I don't want to in any way misrepresent that document.

Q. So at this time the report is -- this report as it sits in front of you is a complete and accurate representation of all your opinions in this case?

A. Yes.

Q. And you refer to Appendix 7 in Section 2.2 of the report. Go ahead and turn to Appendix 7.
A. (Witness complying).
Q. Oh, and it's the second Appendix 7. You have got one that is Cost of Upgrading Net Pen Systems and the second one, which is List of Records Considered. I am looking at List of Records Considered. It could be Appendix 8.
A. Thank you for catching that.
Q. Sometimes we pay attention to that kind of stuff.
Is this still an accurate list of the records that you had considered in forming your opinion?
A. I believe it is.
Q. And who provided these records to you?
A. Primarily these records were provided by the counsel for the Wild Fish Conservancy.
Q. Were there records that you obtained on your own?
A. I referred to certain documents such as industry standards, such as the NS 9415 standard and the Best Aquaculture Practices standards and other publicly-available resources that we use in our line of work.

Q. And are those -- you say NS 9415, is that the second bullet from the bottom on page 59?
A. Yes.
Q. And then below that is the Washington Fish Growers Association Code of Conduct?
A. Correct.
Q. And then on page 60, are those records that you were provided by counsel or that you gathered on your own?
A. We can go through one by one.
Q. Let's do that.
A. The first bullet on page 60 was something I gathered on my own.
The second bullet, I don't recall whether I gathered that on my own or whether that was provided by the counsel. Yes, I don't recall.
The third is something I gathered on my own.
The fourth bullet, BLS, the Bureau of Labor Statistics, I accessed on my own.
The fifth bullet is also the Bureau of Labor Statics that I accessed on my own.
The next bullet, Munson, was accessed on my own.
The next was NADA, that is a

publicly-available website.

The DTX2 Package, the Deep Trekker, is a publicly-available website.

The SeaOtter-2 ROVER reference is a publicly-available website.

The Currency website is publicly-available.

The Soy Aquaculture Alliance reference is publicly-available.

And then the second to the last bullet point is records produced by Cooke in this litigation. That would be -- that have been provided by the counsel.

Current Data and Related Files From Cooke Current Study in Late 2017, slash, early 2018 were provided by the counsel.

Q. Okay. And just to be clear, there's no other records that you gathered on your own in preparing this report besides those listed in the second appendix seven?

A. Not that I can think of.

Q. Let's go back to page seven of Exhibit 2.

A. (Witness complying).

Q. Section 3.1.1, let me ask, and I may be repeating myself.

Have you advised clients on compliance with National Pollutant Discharge Elimination System permits?

A. I believe some of the questions I have gotten from clients about current compliance relate to NPDES, but I don't generally check whether they -- where the requirements come from.

Q. What -- what types of industries? Are these finfish aquaculture industries or mussel raft?

A. I believe these are applicable to most aquaculture industries. I think most recently I encountered NPDES questions, and this is -- this is my -- my best recollection. This isn't something that I investigated thoroughly, but I believe my most recent NPDES related questions related to mussel culture.

Q. Were those mussel rafts in Maine?

A. No.

Q. Where were they?

A. Again, I try to be careful with my non-disclosure agreements.

Q. Were they permits issued by a state or the federal government?

A. I believe these were federal permits, but --

Q. Issued by the EPA?

A. Let me -- let me -- let me keep going there.
So again I don't -- I don't generally concern myself with where certain requirements are coming from. If the client says we have permit requirements, then -- then they -- then I operate based on that statement. So I will avoid speculating on exactly where certain requirements came from.
Q. When a client gives you a requirement, do they give you a copy of the permit or do they generally describe the requirement to you?
A. It varies, but more likely -- more commonly it's the latter. More often they say that they have a certain requirement, and I -- and I engineer to meet that requirement.
Q. What types of requirements have you engineered to meet?
A. Generally the permit requirements are either about the structural integrity of the system -- yeah, that's the most common.
Q. And you haven't advised clients on things like how to contain oils or other materials on mussel rafts, things like that?
A. That would all be within -- within the question of structural integrity. If -- if

aquaculture systems break, then there is an ecological impact. So my primary concern, among -- among multiple design criteria, is generally structural integrity.

Q. Going to page seven. You have a Table 1 and Table 2.

Who provided these tables to you?

A. Table 1 is from Cooke's answers to WFC second d-i-s-c reqs, I believe that is discovery requests. That was a document provided by the counsel.

Q. What about Table 2?

A. Table 2 is from the same documents.

Q. And did you review all the documents listed in these two tables?

A. I reviewed certain NPDES pollution prevention plans. I would have to think about whether every one listed -- whether I reviewed every one listed.

Q. Have you reviewed or provided advice on pollution prevention plans to clients prior to your expert engagement?

A. Again, I haven't directly written plans. I advise on specific questions from the clients based on their permit requirements.

Q. Can you identify any permit requirement that -- that you have advised clients on that was derived from a pollution prevention plan required under a NPDES permit?
A. I don't know.
Q. You don't know?
A. I don't know what requirements come from which permits or which agencies.
Q. Go to Table 2.
A. Witness complying.
Q. Now, this is a table of fish escape reporting and response plans.
Did you review all of the fish escape reporting and response plans listed in Table 2 as part of preparing your opinions in this litigation?
A. I reviewed certain fish escape prevention plans. I don't know whether this table lists any that I did not review.
Q. Have you ever in the course of your professional activities advised clients on compliance with fish escape reporting and response plans?
A. Prior to this case, I don't believe I have.
Q. Go to Section 3.1.2 on page eight.

You list Best Aquaculture Practices. What are Best Aquaculture Practices?

A. That's an industry standard, one of -- one of many that has been put together by an industry group to help guide aquaculture facilities and companies.

Q. And when was that standard created?

A. They periodically produce new standards. So, yeah, it's an ongoing standards -- standards association.

Q. And have you advised clients on compliance with the Best Aquaculture Practices?

A. When we advise clients, we often use a mix of different aquaculture standards trying to -- trying to maximum their -- their -- trying to make sure their system is as -- as well engineered as possible.

I don't recall specifically whether I have used Best Aquaculture Practices, that standard for clients, prior to this.

Q. Have you helped clients obtain certification under the Global Aquaculture Alliance, Best Aquaculture Practices?

A. I don't know whether any of my work has been used to support Best Aquaculture Practices

certifications.
Q. Have you advised clients on compliance with Best Aquaculture Practices as it relates to salmon farming in particular?
A. I don't think so.
Q. Section 3.1.2.1 is the Washington Fish Growers Association Code of Conduct.
Did you research and obtain this code of conduct as part of your expert opinion preparation?
A. I believe we obtained it on our own separate from counsel. I -- I don't remember specifically.
Q. Is this the result as -- of some Google research or something like that?
A. I don't remember if we had to find it. We have -- in our company, we have a library of standards. I don't remember if it was -- if we had it previously or if we had to obtain it for this case.
Q. You say we. Were there other people who were helping you gather these standards?
A. Yes. Mr. Richard Akers is a professional engineer in our office. He is listed on -- early in the report as helping me gather data

for my report.
Q. And have you ever advised clients on compliance with the Washington Fish Growers Association Code of Conduct?
A. No.
Q. Section 3.1.3, Norwegian Standard 9415.E:2009.
What is this standard?
A. This is a standard that comes from Standards Norway. It's a leading standard in the aquaculture industry for finfish and it's also -- we also use it for other aquaculture applications.
Q. And have you ever advised clients on -- on compliance with the Norwegian Standard?
A. We use this one quite often, yes, for -- as a reference for defining worst case loads on aquaculture systems and required safety factors and load factors, for example.
Q. Have you applied these standards to salmon farms in your professional experience?
A. No.
Q. Go back to page five.
A. (Witness complying).
Q. Going to go through -- let's go through the summary of your opinions.

The first one -- go ahead and review the first bullet.
A. (Witness complying).
Q. Is this still an accurate representation of your opinion with -- opinion with respect to the subject matter in the first bullet?
A. Yes.
Q. And I'll direct you to the last sentence. You say: Specifically, Cooke did not annually inspect anchoring components that were below a depth of 100 feet.
Can you identify the sites or the years where you believe Cooke did not annually inspect below 100 feet?
A. I will have to review my reports. Would you like me to?
Q. Go ahead.
A. (Pause). Part of my job as an expert witness on this case was to help answer the question of whether Cooke complied with its permits. To do that I reviewed documents that had been requested from Cooke and provided by Cooke in response to the question of whether they were annually inspecting their mooring system, including moorings below 100 feet.

To form my opinions I -- I sorted through the documents that I was provided and attempted to put together or find any record, or comprehensive records, provided by Cooke in answer to the question of whether they annually inspected the moorings.

The best record that we found and that I reviewed was a spreadsheet that is referenced in my report, or a collection of spreadsheets. One for -- for -- each one relating to a specific site. Those are listed on page 15 of my report.

Q. Are the records listed on page 15 of your report the complete universe of records that forms the basis for your opinion that Cooke did not annually inspect anchor components that were below a depth of 100 feet?

MR. CASSIDY: Object to the form of the question.

A. No, I can't state that everything is contained on this one page.

BY MR. STEDING:

Q. Okay. And also on -- with respect to the first bullet, explain to me why you believe that the NPDES permits had a requirement of

annually inspecting anchor components below a depth of 100 feet.

A. To be clear, we are going back to page -- was it six?

Q. Page five.

A. Thank you.

Q. First bullet.

A. My opinion was that Cooke did not inspect all portions of mooring systems on an annual basis as required by section S6.F of its National Pollution Discharge Elimination System Permits. And as --

Q. Can you go to Tab 1 of your binder and take out that document, please, and hand it to the reporter. We're marking it as Exhibit 3.

(Deposition Exhibit No. 3 was marked for identification.)

Q. You have been handed a document that has a Bates stamp at the bottom that says COOKE CWA 00019607, and it's referenced in your report. It's a National Pollution Discharge Elimination System Waste Discharge Permit issued by the state of Washington for Site 2 - Deepwater Bay.

Did you review this as part of the

preparation of your opinion?
A. Yes.
Q. And did you review other versions of this NPDES permit?
A. I believe there is multiple versions, yes.
Q. Are there versions for other sites?
A. If I recall correctly, there -- each site has its own permit. However, much of the -- much of the text is the same between sites.
Q. Okay. Can you -- can you direct me in this permit to the -- the provisions that mandate inspecting anchor components below a depth of 100 feet?
MR. CASSIDY: I am going to object to the extent it calls for a legal conclusion.
But you can answer. Go ahead and answer the question.
A. Okay. First of all, my opinion was that -- and let me turn back to it to make sure I am not confusing anyone with the wording.
My opinion is that the National Pollution Discharge Elimination System -- let me rephrase. The facts on which I am basing this opinion, or one of the facts, is that the NPDES permit requires an annual inspection of

the moorings.
That is the question at hand, correct?
BY MR. STEDING:
Q. The question is, I want to understand the factual basis for your conclusion that the NPDES permits require an annual inspecting of anchor components below 100 feet.
MR. CASSIDY: Same objection, to the extent it calls for a legal conclusion.
But you can go ahead.
A. Sure. I will read from section 6S -- let me start again -- s6.F of the NPDES permit. This relates to the requirements of the pollution prevention plan. And it requires that the permitee must address the following in the plan. And I am reading from page ten of my report. At least once per year conduct an inspection of the main cage structure and anchoring components above and below the waterline.
BY MR. STEDING:
Q. You interpret that to mean -- and it's your opinion that Cooke did not comply with that provision by not inspecting anchoring components that were below a debt of 100 feet?

A. That is one -- at least one way in which they did not comply with that provision.
Q. What are the other ways?
A. I don't have evidence that they necessarily inspected annually the moorings that were not below 100 feet.
Q. Okay. Go back to bullet -- the first bullet on page five. You state that Cooke did not inspect all portions of mooring systems on an annual basis as required by section S6.F of its NPDES permits and as stipulated by the net pen manufacturers' manuals provided by Cooke.
Is it your opinion that the NPDES permits require compliance with manufacturer recommendations?
MR. CASSIDY: I will object to the form of the question and to the extent it states -- it asks for a legal conclusion, but...
A. In this application, the guidance from the net pen manufacturers clarifies the interpretation of the NPDES permits.
BY MR. STEDING:
Q. What do you mean by it clarifies the interpretation of the NPDES permits?
A. So the NPDES permits, as I read a minute ago,

require inspecting the moorings annually. Looking at the -- the net pen manufacturer recommendations, they describe what an inspection should look like and that includes everything in the mooring system all the way down to the anchors.

Q. Let's go to the second bullet on page five.

And have you reviewed documents since the formation of this opinion, since June 5th, that would change your conclusion that the net pen -- I'm reading the last piece of bullet two -- that the net pen systems may be at risk of partial or catastrophic failure during instances of extreme environmental loading?

A. I have not reviewed documents that would change my opinion.

Q. So this opinion is still accurate as we sit here today with respect to that subject point?

A. Correct.

Q. And how long do you believe Cooke as been violating the NPDES permit requirement to identify and implement technology that will minimize fish escapements?

MR. CASSIDY: Object to the form of the question, to the extent it asks for a legal

conclusion, but...
A. I haven't -- I haven't spent time mapping out how long they have been in violation of this requirement.
BY MR. STEDING:
Q. So you haven't -- you don't have an opinion on whether they have been in violation of this permit -- this requirement in 2012?
A. I could -- I could look back at my report and see whether -- whether specific violations occurred in specific years.
Q. Why don't you go ahead and do that.
What I am specifically asking you is whether you have an opinion on when they first violated the requirement to identify and implement technology that will minimize fish escapements.
MR. CASSIDY: I am going to make the same objection to the form of the question, to the extent it asks for a legal conclusion.
But you can answer.
A. Yeah. Maybe the most helpful thing would be for me to break this down by the specific -- the specific opinion that we are talking about, so we are talking about the failure to

identify and implement technology that will minimize fish escapements. Specifically, that relates to conditions at each of its eight sites exceeding the maximum rated conditions specified by net pen manufacturer, and those have different -- different aspects of that have occurred at different -- different years. Certainly these sites for these net pens, for as long as they have been in currents that exceed the structural capacity of the raft as specified by the manufacturer, that has -- those currents have been in place since the rafts were installed.

Other violations such as other -- other aspects of the configuration that endanger the structural integrity of the raft, some of those have evolved over time. For example, I think -- I think that Cooke installed -- changed the net configurations for some of the sites after the original installation. So we would have to go through on a case-by-case basis, which I'm really not prepared to do right now.

BY MR. STEDING:

Q. Why are you not prepared to do that right now?

A. Because my -- my conclusions are generally independent of the timing of -- of -- of certain violations. Where -- where timing is relevant I believe it's noted in my report, but I -- I can't think of an efficient way to compile the timelines.

Q. Can you show me where it's noted in your report where timing is relevant?

A. Sure. One example that comes to mind is, in relation to the scope of my work, is in estimating costs avoided. You were asking about mooring inspections a few minutes ago, so we can use that.

Let's look at Section 4.3.2.3. That is page 17 of my report. This --

Q. Let me clarify. I am asking about the timing where Cooke failed to identify and implement certain critical net pen technologies necessary to prevent escapes.

When did Cooke first fail to identify and implement certain critical net pen technologies necessary to prevent escapes?

A. The first date that I considered in my work I believe went back as far as 2012, in the year 2012. Most, but not all, of these systems had

been installed in -- in sites where the current conditions were too large to safely operate the systems that they installed.

Q. Have you ever advised clients on installation of steel salmon farms in siting and assessing the conditions for installing those?

MR. CASSIDY: Object to the form of the question. It's also been asked and answered.

But go ahead.

A. Right, I have not. Most of my work is in other aquaculture fields.

BY MR. STEDING:

Q. And to clarify, you are not familiar with industry practices related to installing salmon farms, steel cage salmon farms like the ones at issue in this litigation, say in 1999?

A. That is not correct. I am familiar with the practices necessary to safely install such systems because they are the same practices that we use in all of the aquaculture industries.

Q. Are you familiar with the practices that were implemented by the salmon farming industry in 1999 with respect to installing steel cage salmon farms?

A. To the extent that the practices are the same that we use today, which -- which in general they are, yes, I am familiar with those practices.

Q. So it is your opinion that the practices used today in 2019 are the same as the practices that were used in 1999 with respect to installing steel cage salmon farms --

MR. CASSIDY: Object to the form.

Q. -- in sites --

MR. CASSIDY: I'm sorry, sorry. Object to the form.

A. I certainly won't claim that everything is identical. I am not making any kind of absolute claim. But in general the practices that we use to safely engineer aquaculture systems and install them have -- have -- the basic principles are the same.

BY MR. STEDING:

Q. And what is your basis for the opinion that the basic principles are the same?

A. The basic laws governing the loads, fluid loads on structures have been well understood since at least 1950.

The laws of mechanics of steel structures

have been well understood for decades, if not a couple centuries.

The practices for installing anchors in marine locations, that the types of anchors used are the same types of anchors that have been used for decades.

The types of buoys, lines and structures and generally the same -- the same, serve the same purpose and are of the same general nature as have been used for decades.

Q. Were you practicing as a marine engineer in 1999?

MR. CASSIDY: Objection to the form. Asked and answered.

Go ahead.

A. No, I was not.

BY MR. STEDING:

Q. Did you interview any marine engineers that were practicing or -- or in the field of advising salmon farmers on siting steel cage systems in 1999 --

A. I have certainly discussed --

Q. -- as part of your --

A. Did you have -- do you want to adjust the question?

Q. Let me ask the question again.
As part of forming your expert opinions, did you interview engineers that had experience with installing steel net pen cage structures in 1999?
A. No.
Q. Did you -- what about for 2000 or for any other time period?
MR. CASSIDY: Object to the form of the question.
A. Let me make sure I understand the question. Did I interview engineers familiar with steel net pen aquaculture installations during any time period in forming my opinions for this case. Is that the question?
BY MR. STEDING:
Q. That is the question.
A. I did not.
Q. And you mentioned that you -- that -- and I don't want to mischaracterize what you just said to me, but you talked about the -- the -- the laws of physics being the same in 1999 as 2019.
What about the practices of installing a net pen facility, what is done in terms of

engineering or application of standards? Has that changed between 1999 and 2019?

A. Standards have certainly evolved since 1999 and the present day. Certain -- certain engineering practices have -- have evolved. The basic engineering principles have -- have not.

Q. Was the Norwegian standard promulgated prior to 1999?

A. The 2009 version was definitely not distributed prior to -- or in 1999.

Q. Do you know when the Norwegian standard was first adopted for -- to be applied to salmon farms?

A. Adopted by whom?

Q. Adopted by the Norwegians.

A. I don't know how to answer that question, no. There's -- each standard is -- each -- any reference to a year in a standard means that's its own standard. So, no, no standard is applicable before the year it was issued.

Q. Do you know the date of version one of the Norwegian standard?

A. I don't know what version one is. Do you have a copy?

Q. Do you know if the Norwegian standard pre- or postdates the date on Exhibit 3, the NPDES permit that you reviewed?

A. I am not trying to be obstinate. I -- when you say "the Norwegian standard", that could refer to a lot of things. Certainly this NS 9415 2019 is not applicable before 2009.

Q. So I am asking about NS 9415, and I get that the version that applies now that you have referenced is the 2009 version of that standard.

Are you aware of other versions, like NS 9415 2007 or one from 1999 or earlier?

A. I don't know the history prior to the 2009 version.

Q. Did you attempt to understand the history of that standard as part of formulating your opinions?

A. No.

Q. What about with respect to the Best Aquaculture Practices standard, do you know when that was first promulgated?

A. I don't.

Q. Do you know whether that standard was promulgated before or after the date of the

permit in Exhibit 3?
A. I don't.
Q. Go back to page five --
MR. STEDING: Well, we've been going for about an hour and 30 minutes. Do you want to take a five-minute break?
THE WITNESS: Sure. Sure.
MR. CASSIDY: Doug, what's your --
MR. STEDING: I was just about to ask that.
MR. CASSIDY: Yeah, let's go off the record.
Is it all right to go off the record, Doug?
MR. STEDING: Yeah.
(Off-the-record colloquy.)
(Lunch recess taken.)
MR. STEDING: How was lunch, Dr. Dewhurst?
THE WITNESS: It was fine. How was yours?
MR. STEDING: Great. Not yet. Bagel and cream cheese for me.
THE WITNESS: That's right.
BY MR. STEDING:

Q. During the break -- did you discuss your testimony with counsel during the break?
A. Yes.
Q. What did you discuss?
MR. CASSIDY: Objection. Calls for privilege.
MR. STEDING: He's an expert and discussions with counsel are not privileged.
MR. CASSIDY: Since when?
BY MR. STEDING:
Q. Do the discussions impact your testimony today?
A. No. Counsel's advice was generally to tell the truth and be straightforward.
Q. So nothing -- nothing related to your lunch conversation changes your testimony from this morning?
A. Correct.
Q. Okay. Back to Exhibit 2. Let's look at the fifth bullet, which starts with --
THE REPORTER: I'm sorry. Could you -- could you just repeat, it starts with? I'm sorry.
MR. STEDING: Apologies.
Q. The fifth bullet, which starts with, while

achieving certainty with regard to the cause of the Cypress Site 2 failure. Go ahead and review that bullet, Dr. Dewhurst.

A. (Witness complying). Okay.

Q. Is it your opinion that Cooke failed to attempt an analysis of the failure of Site 2?

A. That is my understanding of the facts.

Q. Are you aware of any other analyses of the failure of Site 2?

A. I am aware of certain reports on that failure, specifically a state agency report.

Q. Did you review the findings of that report?

A. I did.

Q. Did you review any documents related to the work Cooke did with those agencies after the collapse of Site 2?

A. Certain documents that I can think of refer to Cooke and the state working together particularly in the days after the collapse.

Q. Are you familiar with the Mott MacDonald reports commissioned by the Department of Natural Recourses inspecting the Cooke facilities?

A. Yes.

Q. Did you review those reports as part of

preparing your expert opinions?
A. Yes.
Q. Were you provided with complete copies of all of those reports by counsel for WFC?
A. I have assumed that the copies that I have are complete.
Q. And you reviewed all of those reports?
A. I reviewed the reports. I will not claim to be able to regurgitate any particular section of them.
Q. Did you rely on these reports in forming your opinion about the failure of Site 2?
A. The only portions of those reports that I considered to be able to rely on was their observations from visiting the sites.
Q. Why did you not consider the other portions of the reports something that you could rely on?
A. I wanted to be careful not to rely on other expert or non-expert opinions and base my opinion solely on the facts.
Q. Were those reports prepared by professional engineers?
A. Yes.
Q. Would you find that licensed professional engineer opinions to be generally reliable?

A. Generally I -- I find that licensed professional engineers often yield credible decisions. I don't want to make any kind of claim as to whether they can be relied upon by another expert in the court of law.

Q. Did you -- did you review any records about Cooke and its net washing activities that it implemented after the Site 2 collapse at its other facilities?

A. I don't recall whether there were documents that addressed specifically net washing practices after the August collapse.

Q. Do you recall -- sorry, that was my door closing -- do you recall reviewing any videos of the conditions of nets before or after the collapse of the Site 2 facility at any of Cooke's facilities?

A. The only video that I can think of of a net prior to the collapse is -- would come from a set of video and photos taken, I believe, by one of the state agencies of the Cypress Island Site 2 debris including the nets.

Q. So you did not review videos of conditions of nets at other Cooke facilities after the collapse of Site 2?

A. No, not that I can recall.
Q. Are you familiar the engineering firm DSA?
A. Yes.
Q. And did you review reports prepared by DSA in developing your opinion about Cooke's response to the Cypress Site 2 collapse?
A. I reviewed the reports from DSA. I -- I have not seen any investigation from DSA into the -- Cypress Island Site 2 collapse.
Q. Do you consider the work of DSA to be generally reliable and conform to professional engineer standards?
A. They have not done any work for us directly, but they have a good reputation in the field.
Q. And the reports that you have reviewed are generally compliant with professional engineer standards in the field of marine engineering?
A. Yes.
Q. Go to bullet number six, and we've tread similar grounds. I just want to clarify a bit.
You cannot, sitting here today, provide a timeline of the dates or years in which Cooke failed to inspect all portions of mooring systems on an annual basis. Is that correct?

A. I cannot efficiently construct that timeline. My report is not organized to be an exhaustive list of all failures, nor is it organized chronologically.

Q. And with respect to bullet number six, the sentence says: Cooke also avoided costs in failing to identify and implement technology to minimize fish escapes.

What are the technologies that Cooke failed to identify and implement?

A. The critical technology that Cooke failed to implement is net pen systems that were structurally sufficient for the conditions in which they were operating.

Q. And is it your testimony that the net pen systems have been structurally insufficient since the date of installation?

A. I don't think that I have made that claim specifically.

Q. Have you evaluated whether or not the net pen systems were structurally sufficient at the date of installation?

A. My analysis generally only goes back to 2012. For that time none of the net pens that have been installed -- to my knowledge none of the

net pens -- let me rephrase.
Can you ask your question specifically?
Q. Let me ask the question again.
Have you formed an opinion about whether or not the net pens were considered structurally sufficient at the time they were installed?
A. My -- my opinions -- no, I did not form my opinions to cover any of Cooke's operations prior to 2012. However, the basic --
Q. Let me ask a related question.
A. The --
Q. In your professional work, have you been -- ever been asked to assess the structural integrity of an existing fish farm operation?
A. The answer is yes, but if you would like to distinguish between finfish and shellfish, I have not been asked to assess the structural integrity of an existing finfish farm.
Q. That was my question, sorry. My question was specific to finfish farms, whether or not you have been asked to assess the structural integrity of a finfish -- an existing finfish farm?
A. Not prior to this case.

Q. Have you performed any assessment of structural integrities of a finfish farm, an existing finfish farm, as part of your professional activities?
A. No.
Q. Has anyone in your firm performed the structural assessment of an existing finfish farm as part of their work?
A. I don't know. The firm has existed longer than I have been there.
Q. Did you ask your colleagues whether or not they had performed structural assessments of existing finfish farms as part of their professional work?
A. No.
Q. Did you ask your colleagues if they have performed site assessments or siting activities for finfish farms as part of their professional work?
A. No.
Q. Has anyone in your firm, to your knowledge, performed siting activities for finfish farms as part of their work?
A. Not to my knowledge.
Q. Go back to Exhibit 2. Let's -- let's ask a

little bit more.
Same question for existing shellfish farms. Have you been asked to perform structural assessments of existing shellfish farms?
A. Yes.
Q. How many structural assessments?
A. I can -- I can try to count off the top of my head. Two come to mind.
Q. How many?
A. Two.
Q. Two?
A. (Nod).
Q. And have you been asked to perform siting work for new shellfish farms?
A. What do you mean by siting work?
Q. I mean assessing the local conditions of a proposed location of a shellfish farm.
A. So those could be interpreted as two different questions. I'll answer the latter.
When it comes to assessing the local conditions of a -- for a shellfish farm, yes, I have done that.
Q. How many times have you done that?
A. For shellfish, three come to mind.

Q. And were those farms built?
A. Two of them were built. One is not built yet.
Q. And I assume when you assessed those site conditions, did you provide engineering analyses of moorings and structures?
A. Yes.
Q. And as part of providing those engineering analyses, did you provide recommendations on inspection or maintenance of those structures?
A. I provide recommendations but not a former -- not a formal maintenance or inspection schedule.
Q. And what type of recommendations did you provide?
A. Recommendations on the frequency of inspections, for example, and referring the clients to -- that covers it, the recommendations on the frequency of inspections.
Q. Did you consult manufacturers' recommendations in making those recommendations?
A. When applicable, that is the first source for a given condition or a given farm. But again my advice is not a formal inspection plan or a -- or a maintenance plan. I simply offer

advice for that particular --
Q. Have you ever composed a formal maintenance plan or inspection plan for a client?
A. No.
Q. Has anyone in your firm ever composed a formal inspection or maintenance plan for a client?
A. I don't know.
Q. Did you ask if anybody has ever provided advice or composed such plans for aquaculture farms?
A. No.
Q. How much of your work, your professional work, is aquaculture related?
A. Speaking loosely, 80 to 90 percent.
Q. 80 to 90 percent of your work is aquaculture work?
A. Correct.
Q. And that's the -- the two facilities that you mentioned previously?
A. No. It covers much more than that.
Q. And what other industries do you serve?
A. Besides aquaculture?
Q. Yes.
A. Marine renewable energy is a --
Q. What kind of marine renewable energy?

A. As a firm we do work for floating offshore winds. We do work for wave energy clients. We do work for marine current energy conversion clients.

Q. Is that work that the firm does or is that work that you do?

A. Both. My work within that has been mostly on the wave energy conversion clients. Some on the tidal energy conversion, and some work in the floating offshore winds world.

Q. Let me ask -- let me switch gears a little bit.

In the work that you have done in aquaculture, have you ever assessed the structural integrity of an existing mussel raft?

A. Yes.

Q. And what did you do to assess the structural integrity of the existing mussel raft?

A. I took the engineering approach that is fairly standard in our industry -- and I'll clarify this was a partial assessment, so the client had a specific question that I was contracted to answer. So the general -- in that case, there was no -- there were no manufacturer

guidelines for the -- for the system because it was built by the client. So my role was to provide an engineering assessment of the wave and current loading on that system and -- and compute the maximum forces in the system under those extreme environmental loading conditions and then specify to the client those -- the forces that must be sustained by the mooring system and the raft structure.

Q. What did you do to assess the forces on the structure?

A. The engineering approach that I use most often, which is what I used for this case, is -- uses engineering models, so numerical models based on the physical, structural, and hydrodynamic properties of the farm components.

So the basic approach is to break the -- the system into small finite elements, which I have described before, and then the simulation software that we use computes the forces on each one of those elements as a function of the relative incident fluid velocity and acceleration and the internal structural forces from the rest of the components. And

if you apply that simulation under the maximum expected extreme environmental loading scenario, that gives you the forces which your structure must be able to survive.

Q. In order to make those calculations, what kind of data did you gather?

A. I gathered current measurements from the site and wave measurements, also gathered extreme wind speed data from a nearby site. I gathered structural and mechanical properties of the components of the raft and the mooring system. And I worked with the customer to develop a maximum allowable biomass for the -- for the farm.

Q. Did you gather information about the length of the mussel lines, if I'm using that term right in what we were talking about earlier, the 45 foot that we discussed earlier?

A. Yes, those were reported by the customer.

Q. Did you gather information about the number of those lines?

A. Yes, those were reported by the customer.

Q. Did you gather information about the maximum diameter of those lines?

A. Yes.

Q. And all of those parameters are necessary to calculate the load on a facility, right?
A. Yes.
Q. And without those parameters you cannot calculate the load on the facility; is that correct?
A. Cannot is a strong statement. If I did not have those parameters, if I were to provide guidance on -- on ensuring the structural integrity of the system, then I would work with the client to figure out a maximum allowable parameter, and that's what I would use in my analysis, and that would be the limit on what the structure was -- was prescribed to be able to survive.
Q. Would you perform that analysis without information on the length of the lines?
A. No. I would either collect that data or specify a maximum allowable value.
Q. The same question for the number of lines or the dimensions of the facility, you need that information to calculate loads; is that correct?
A. You need to either -- again, it goes back to what is the purpose of your analysis. If you

are trying to specify the -- the minimum required capacity of the structural components, then you need to analyze the system under its maximum allowable loading configuration.

Q. Which requires the knowledge of the length of the lines, the thickness of the lines, and the number of the lines.

MR. CASSIDY: Objection. Form of the question.

Go ahead.

A. If your purpose is to assimilate the system at a certain moment in time, you need some estimate of those parameters at that moment in time. If your purpose is to -- to engineer the system to make sure it is structurally sound, then you -- then you design the system for a maximum allowable value for that parameter.

BY MR. STEDING:

Q. Okay. I think you just mentioned -- I want to clarify. Did you apply a numerical simulation as part of developing your expert opinion about Cooke's facilities?

A. No.

Q. Why did you not do that?
A. When I -- when manufacturers -- when manufacturer ratings exist, then -- then they -- I was able to form my opinions based on those.
Q. Go to page 19 of your report.
A. (Witness complying).
Q. I am looking at Table 3.
I assume you prepared this table?
A. I did.
Q. And what's the basis for the information in Table 3?
A. There are at least four sources of information for this table. For the second column, the Marine Construction SystemFarm, that is based at a minimum on a letter from Marine Construction to an employee of Cooke in response to the question of what their -- what the -- what the environmental -- what the maximum allowable environmental conditions were for these net pen systems. The basis --
Q. Is it -- is the information in that first column based solely on the letter that you just referred to?
A. I won't claim that without looking at it. I

can pull this up.
Q. In your binder -- yeah, sure. In your binder, go to Tab 33. And let's remove that document, and I think that will be Exhibit 4? Tab 33.
(Deposition Exhibit No. 4 was marked for identification.)
Q. Do you have that marked as Exhibit 4?
A. Yes.
Q. So you have been handed what has been marked as Exhibit 4, and it is a letter from Steinar Olsen at Marine Constructions to Kevin Bright dated 10 March 2015.
Is this letter the source of the information in the first column titled Marine Construction AS SystemFarm in your Table 3?
A. It is the source of some of the information.
Q. What is the source of the rest of the information?
A. The manual for the Marine Construction SystemFarm.
Q. Let's go to tab -- is that what is referred to as -- on Footnote 35?
A. I will have to check.
Q. Go ahead and go to 35.
The Footnote 35, I believe, is for the

Wavemaster cages, so I don't want to mark it as an exhibit right now. But I want to ask you where in your report you're referencing a manual for the Marine Construction farm as the basis for the information presented in that table?

A. So let's go through row by row.

The current speed in the SystemFarm in the -- for the Marine Construction current farm is listed in this letter. The maximum allowable wave at the period are listed in this letter. The net width and net length I believe are -- are not in this letter and rather came from the manual. So I apologize for dropping the footnote there.

Q. Do you reference the manual somewhere else in your report, because I haven't seen it?

A. Okay. I would have to look through to figure out whether it was referenced elsewhere. If I -- if I don't have it referenced elsewhere, I again apologize.

Q. Did you -- did you obtain this manual on your own or was it provided to you by counsel?

A. It was provided by counsel.

Q. But the manual does not specify net twine

diameter; is that correct?
A. I don't recall off the top of my head whether that information is in the manual, but I think it -- I think that is correct based on looking at this table.
Q. And you did not have information about the manufacturer specifications in net twine diameter --
A. Correct.
Q. -- in conducting your assessment of the Marine Construction farms; is that correct?
A. I believe that is correct.
Q. And you did not have information with respect to the level of allowable biofouling as recommended by the manufacturer of the Marine Construction system; is that correct?
A. Correct.
Q. And you did not have information regarding mooring tension as recommended by the manufacturer of the Marine Construction farms; is that correct?
A. Correct.
Q. And you did not contact Marine Construction to get that information; is that correct?
A. That is also correct.

Q. And where did the information about specified monthly and annual inspection sheets come from?
A. That also comes from the manual.
Q. Does that manual say anything about the types of inspections?
A. Let me see what I have quoted elsewhere in the report.
Looking at my report I don't think I quoted directly from the Marine Construction manuals, so I would have to look at that document before answering with certainty.
Q. Okay. Well, let's see if we can locate it; and if we can, we'll e-mail it to the court reporter.
A. I can add to that answer. I can add to that answer --
Q. Go ahead.
A. -- as I have been scanning through my report.
What I do state in my report about the Marine Construction inspections, and this is true -- I am reading from page 13, the second paragraph -- for both systems that covers the Marine Construction and the Procean system, the annual inspections include items above and

beyond those included in the weekly or monthly inspections.
Q. Let's look at that. Is that -- is that the second paragraph on page 13 that starts with the Marine Construction AS SystemFarm manual?
A. Yes.
Q. And you've got a Footnote 12.
Is Footnote 12 the manual?
A. I believe that is incorrect, and again that is my mistake and I apologize. It looks like the footnote reference there, somehow I switched the footnote reference with the manual and the letter. So again I apologize.
Q. Is the manual referenced in any footnotes in any of these documents?
A. I don't know without going through and checking them one by one.
Q. You go on to state that -- but the majority of that paragraph is about the Procean manual, not the Marine Construction farm manual; is that correct?
A. That's the one I quote as an example of inspection requirements.
Q. Go back to page 19, Table 3. With respect to the Marine Construction SystemFarms, in order

to assess loading on the farms and compare it to manufacturers recommendations, would you need to understand net twine diameter?

A. No, actually, to compare it with the manufacturers recommendations.

Q. Why not?

A. The fact that the current speeds, for example, for Cypress Island Site 2 -- let's look at Table 4 of the report. The extreme current speeds for which that system should have been suitable were 153 centimeters per second. That's compared to the 50 centimeters per second specified as allowable by the manufacturer. So anytime a system is outside of the specs for any -- for any specification, if you are operating outside of the manufacturer allowed specifications, the customer would need to do -- or the customer or the manufacturer would need to do an engineering analysis to see whether the resulting loads exceeded the structural capacity of the system.

For this particular case where currents at that location were three times what the manufacturer specified, questions about twine

diameter would not be my first concern as --
as an engineer.
Q. Have you performed a loading analysis on the Marine Construction SystemFarms, comparing currents at Cypress Island with those specified by the manufacturers, to determine that the conditions at Cypress Island are outside of the manufacturers recommended specification?
A. So you asked two questions there. One was about loading analysis and another is about the conditions.

My analysis -- I did analyze the currents at the Cypress Site 2 site based on data provided by Cooke through counsel, and they are very far outside of the manufacturer specified maximum allowable current conditions.
Q. Did you reach out to Marine Construction to understand what they meant by 50 meters or .5 meters per second?
A. No.
Q. Is that measured according to the Norwegian standard that we talked about previously?
A. I don't know.

Q. Do you know the depth at which that is specified?
A. No.
Q. Do you the level of biofouling that is allowed to have a 50-centimeter-per-second current on it according to the manufacturer?
A. I don't know. It was what they assumed.
Q. Do you know the net twine diameter that is allowed for a 50-centimeter-per-second --
A. I don't.
Q. -- current?
Why did you not reach out to understand what the -- what the manufacturer meant by this 2015 letter that is marked as Exhibit 4?
A. Because the manufacturer stated that the net pen was -- was constructed to meet specific wave heights given and combined with the current velocity up to 0.5 meters per second, and with that net depth the combination of -- of the increased net depth and the finer mesh diameter or finer mesh size and the current speed that is three times the -- the rated capacity, all of those mean that the system is outside of the manufacturers specifications for allowable conditions.

Q. My Ph.D advisor, forgive me, used to have a phrase. He said, how do we know, because we measured it.

Did you perform any numerical modelling to confirm your conclusion and your opinion that the Marine Construction farms are at risk of collapse because they are outside of manufacturer speculations?

A. No. My opinion was that -- was that they are outside of manufacturer specifications. As engineers, we give specifications to make sure that our clients can safely operate in those conditions. If a specification is -- if an environmental or configuration parameter is outside of those, then they are no longer within that -- those safe conditions.

Q. Let's talk about the Norwegian standard for a minute and go to Table 4. Before we go to Table 4, let's stay on Table 3 for all of these.

Did you do anything to understand how the specifications that are in Table 3 for the Marine Construction farms were developed?

A. I don't know how the Marine Construction group arrived as these limits.

Q. Did you make any inquiries with anybody to understand how Marine Construction cages that are pre 2004 were specified to be suitable for sites?

A. No.

Q. Did you make any attempts to gather that information?

A. The information that I had gathered was this letter, which was an answer to that -- I believe the question that you are asking, and the question is, under what conditions can this net pen be safely operated. And the conditions that were either measured in regard to the current speed or reported by Cooke were very far outside of those conditions.

Q. But you performed no engineering analysis to compare the conditions in the environment with what the manufacturer specified?

A. That is absolutely incorrect. So I did compare the -- I did compare the conditions of the environment with the manufacturer specifications. Those --

Q. You performed no numerical model in making that comparison.

MR. CASSIDY: Object. Asked and

answered.
Go ahead.
A. Yeah, that's correct. That comparison did not involve a numerical model.
BY MR. STEDING:
Q. If a client came to you -- you mentioned -- let me back up.
You mentioned that you have one instance for a mussel raft, you were asked to assess an existing mussel raft, and you did perform a numerical model in that situation; is that correct?
A. Yes.
Q. And why did you not perform a numerical model in this situation?
A. In the case of the mussel raft, there were no manufacturer's guidelines to go on. That engineering analysis had not been done.
In this case, the -- the manufacturer is the first authority on what its cages are designed for, and this letter and the -- the environmental conditions at the site show that the -- the net pen was very far outside of those specifications.
Q. Look at Exhibit 4. The second to the last

sentence says: If loads are moderate an expected lifetime of 20 years can be achieved.

Did you calculate the loads on the Cypress Island with Marine Construction cages?

A. No.

Q. Why not?

A. Because they -- the authority for what those -- the first authority for what those cages can safely withstand is the manufacturer. They are the ones that stated what environmental conditions their system is designed to withstand and the environmental conditions at the Cypress Island Site 2 were very far outside of those environmental conditions.

Q. Did you have all the information available to you to calculate loads on those facilities?

A. I didn't attempt that analysis because it wasn't necessary for performing my report. So I haven't gone through a detailed list of what information was available.

Q. Again, let's look at the second column on the Procean AS Ocean Catamaran 200 ton Silo Barge.

What is the source of the information in this column?

A. So the footnote for that information is COOKE CWA 00026357.
Sorry. Did I misread that?
Q. No. Give me a second here. I am just organizing my thoughts.
Do you have any experience with Procean cages?
A. I have certainly not farmed with them. No, I haven't -- none of our clients have used them.
Q. You have clients that have used them?
A. No, I said none of our clients have used them.
Q. Have you ever been on a Procean cage?
A. No.
Q. Have you ever seen one in person?
A. Not that I know of.
Q. Did you perform any calculations -- or let me ask a different question.
Did you contact the manufacturer of the Procean cages to seek clarification about their specifications?
A. No.
Q. Do you know when those specifications were composed?
A. I don't know off the top of my head. This is what was provided by Cooke in a response to a

request for any manuals or -- or ratings that applied to their system;

Q. Let's go to Tab 34 of your binder. Exhibit 5.

(Deposition Exhibit No. 5 was marked for identification.)

THE WITNESS: Do we have any paperclips or anything for these exhibit? I don't want to mess them all up.

MR. STEDING: It is important for you to keep them together. So if you need to take a pause to make sure we do that, let's do that.

(Off-the-record colloquy.)

BY MR. STEDING:

Q. Okay. You have been handed what has been marked as Exhibit 5. Industrial Farmfishing and Waterpurification, Ocean Catamaran, labelled Procean.

Is this document the source of the information in your Table 3, the second column on Procean AS Ocean Catamaran?

A. Yes.

Q. Go to the second page. Moorings, do you see at the bottom underneath the picture of a walkway it says, the system comes with a mooring specification made for the actual

site?
A. Yeah.
Q. Did you consider that there was a mooring specification that came with these systems when they were installed?
A. That doesn't change my opinion in any way.
Q. Why not?
A. And I also -- I also don't have any records from Cooke about that mooring specification. What I --
Q. Do you know when these structures were installed?
A. There are multiple or there were multiple Procean structures that Cooke had. Off the top of my head, I don't know the installation dates.
Q. Did you assess the installation dates as part of the development of your report?
A. When that information was available, I -- I considered it. Some of the installation dates for certain pens are after 2012 and some are before. I don't know whether the Procean cages were all installed before or after that date off the top of my head.
Q. Did you -- did you ask anybody about an

installation date?
A. I reviewed -- I reviewed -- I relied on the documents provided to -- to assess the -- any relevant installation dates.
Q. You did not perform any additional research on that topic?
A. Correct.
Q. And to be clear, you have no professional experience siting or installing Procean cages of this type?
MR. CASSIDY: Object to the form of the question.
A. I have not installed Procean cages, no, or engineered them.
BY MR. STEDING:
Q. You just referred to relevant dates.
How do you define relevant dates?
A. Dates I was particularly concerned with was any installation or modification of the systems in particular after 2012.
Q. Why are you concerned with that 2012 date?
A. My understanding from counsel is that that was the statute of limitations for this particular case.
Q. And where in your report do you define which

cages were installed after 2012?
A. I don't recall whether I put a timeline like that in my report. I don't think it's substantial to the opinions in my report.
Q. Why is it not substantial?
A. Can I ask why -- can I ask you to expound to why you think it is substantial or necessary?
Q. No. I am asking for you to clarify your statement that the dates of installation is not substantial to your report.
A. Okay.
MR. CASSIDY: I'm gonna object to his characterization of what was said.
But you can answer the question to the extent you understand it.
A. Sure. So we can go through my summary of opinions and see when we need to know the date of installation for each opinion.
Would that be helpful?
BY MR. STEDING:
Q. Sure.
A. Okay. The first bullet point on page five of my report is -- is in regard to Cooke not inspecting all portions of the mooring system on an annual basis as required by section S6.F

of its National NPDES permit. That is independent of when the systems were installed.

The identification and implementation of technology that would minimize fish escapes. My opinion and as documented in my report is that all of the -- the cage systems in some way are outside of manufacturer specifications. Therefore, without further analysis by a marine engineer they are at risk of failure.

The third bullet point is that the apparent lack of rigorous analyses of maximum current speed for each site introduced a risk of structural failure. That is independent of when the systems are installed.

The fourth bullet is that as a result of excessive loads on the net pen system created by, and I'll abbreviate, currents and net sizes exceeding those specified, biofouling levels potentially exceeding design values, and mooring system installations that deviate from manufacturer recommendations, pens operated by Cooke were at risk of complete failure. The risk of failure is

independent -- their risk of failure in relation to those specific issues is independent of the installation date.

The second to the last bullet is in regard to causal analysis. That does not depend on the installation date of the -- of any of the cages.

And the last bullet point is in regard to costs avoided. And in calculating costs avoided, I did look at dates when systems were installed. My costs avoided calculations start in 2012. So any installations after that date I did take into consideration in -- in calculating costs avoided by Cooke.

Q. Good point. Let's look at bullet number four there, and I would like to also have Table 3 handy for reference as we do this.

You state the currents and net sizes exceeding those specified by the net pen manufacturer.

Do you have all the specifications for net size for all of the three types of cage systems to make the conclusion that net sizes exceed those specified by the net pen manufacturer?

A. No, and I am not stating in my opinion that all of the sites exceed those specified.
Q. Do you have information on biofouling for all the sites to be able to make the statement that they potentially exceed design values?
A. My information is that they have the potential to exceed design values.
Q. How do they have the potential to exceed design values?
A. I think the events of the summer of 2017 demonstrate the potential for biofouling to exceed design values.
Q. By summer of 2017, you mean the collapse of the Cypress Site 2 facility?
A. And the events leading up to that. Cooke -- there are many instances referenced in this report of Cooke reporting very high biofouling levels on some of their net pens.
Q. Have you ever assessed biofouling -- prior to this engagement, have you ever assessed biofouling on a net -- a finfish net pen facility as part of your professional work?
A. No.
Q. Have you ever assessed net cleaning technologies as part of your professional

work?
A. Not formally, no.
Q. Have you ever been asked or have you ever performed modeling of the impacts of biofouling on net pen facilities for finfish aquaculture?
A. Not for finfish aquaculture, no.
Q. And you did not perform modeling of biofouling with respect to Cooke's facilities as part of forming your opinions that are contained in this report; is that correct?
A. That is correct; I did not model it.
Q. Back to page five, bullet four, sub-bullet three. You state that mooring system installations that deviate from manufacturer recommendations and were not approved by a marine engineer.
Where did you find the manufacturer recommendations for mooring systems?
A. Let's look at that section of the report. So I believe we will find that -- a specific example in the discussion of the Cypress 2 collapse. Let's take a minute to find it.
So one example of -- of that statement is found on page 30 of my report. I am

looking at the last paragraph where I state that: Modifications to the net pen design and mooring plan were made without consulting a marine engineer. And that comes from the testimony of Mr. Jim Parsons.

Q. Any other examples of Cooke deviating from manufacturer specifications?

A. I believe there are other examples. I will have to see what is documented in -- in my report.

To be clear, my report is not supposed to be a comprehensive list of Cooke's infractions.

Q. Did you contact manufacturers to get mooring specifications for these facilities?

A. I am one question behind you. I am looking for another example, which I believe is in the report, of -- of -- of a mooring layout. But I can -- we can come back to that if you would like since I will have to find that.

Q. Answer that question. Did you contact manufacturers to get mooring specifications for these facilities?

A. No.

Q. And go to page 32 of your document. Maybe

this will help. That first full paragraph you state: Furthermore, the mooring system differs from that recommended by the manufacturer.

What did you do to assess the recommendations of the manufacturer with respect to the Site 2 facility?

A. The last sentence in that paragraph is that the layout differs significantly from the layout specified in the SystemFarm manual. So that is referring to the Marine Construction SystemFarm manual, which again I apologize for not properly footnoting.

Q. Did you assess whether or not that -- that different layout had been established previously by a marine engineer or somebody else?

A. We -- I did my best to ascertain that from the documents provided, and I believe Mr. Parson testified that it had not been -- the mooring layout had not been approved by a marine engineer.

Q. Was that after the -- the July 2017 unmooring and was that Mr. Parson's testimony?

A. I don't recall specifically.

The other --

Q. Do you know if the -- go ahead.

A. The other factors I considered in whether the mooring system on the site complied with one that was specified either by the manufacturer or by a marine engineer is that Cooke did provide marine -- a partial marine engineering analysis of the mooring system for Site 2 specifically, and that's referenced here on this page 32. However, the mooring layout at the site as reported by Cooke was not in compliance with that recommendation.

The system analyzed by marine -- by the marine engineering group, Aqua Knowledge, for example, specified 22 anchors. However, the mooring diagram provided by Cooke, updated on August 3rd of 2017, shows only 20 anchor lines at Site 2 prior to the collapse.

Q. Are there other sites in which you have drawn the conclusion -- besides Site 2, are there other sites where you have drawn the conclusion that the mooring configurations differ from what was specified by the manufacturer?

A. I did not attempt to compile a comprehensive

list of -- of sites that -- where that was the case.

Q. You did not attempt to compile a comprehensive list or any list?

A. I certainly did not attempt to compile a comprehensive list.

Q. What do you mean by a comprehensive list?

A. It was not my goal to -- to highlight every -- every deviation for each of Cooke's sites. The fact -- my conclusion that each one of them is at risk of failure is due to some combination of exceeding manufacturer recommendations or the potential for excessive biofouling or mooring systems that -- that have not been approved by a marine engineer or the manufacturer, and all of the sites fit some of those criteria.

Q. Okay. Let's -- do you understand, or is this in your report, which sites -- which systems are installed at which sites?

A. Yes.

Q. Can you generally describe to me -- let's go back to Table 3. Let's use that as a reference. Page 19 of Exhibit 2.

Where are the Marine Construction cages

operational?
A. Let me catch up to you in turning pages.
Marine Construction --
Q. You can look at Table 4. That is where it is.
A. Yeah. Marine Construction cages are or were operational at Cypress Island Site 1, Cypress Island Site 2, Port Angeles No. 1, Port Angeles No. 2.
Q. And then the Procean cages are at Fort Ward, Orchard Rocks and Clam Bay; is that correct?
A. That is correct.
Q. And the Wavemaster cages are at Site 3, Cypress Island Site 3, and Hope Island; is that correct?
A. Correct.
Q. What I would like you to do in Table 4, for each one of the sites can you identify which of the factors is -- between biofouling or deviation from mooring recommendations, the other factor that you just identified, is -- is the one that causes that facility to be at risk of collapse?
A. Sure. So this table --
Q. Or the combination that causes that to be at risk of collapse. Sorry.

A. This table is specifically about whether the cages were operating in environmental conditions that were within what they were designed for as per the manufacturer.

So starting with Cypress Island Site 1, the -- the currents at that site are well -- well over two times the rated current, at least 2.5 times the rated current.

And I should point out here that the loads on an aquaculture system are nominally proportional to the square of the current speed. So if we talk about, for example, Orchard Rocks where the current is 25 -- or where the current is more than five times the allowable current as per the manufacturer, that does not mean that the drag load on the system is -- is five times the -- the allowable load. It means that it's nominally 25 times the allowable load because the drag force is proportional to the velocity squared and not just the velocity.

So at Cypress Island Site 1 the -- there are two concerns, three concerns, and I am looking the Table 4 and 5. So the concerns with Cypress Site 1 are that the currents are

much higher than those allowed by the manufacturer regardless of exactly what method you use to calculate those currents.

The wave heights calculated by the -- by DSA are higher than those allowed by the manufacturer.

And the depth of the nets as reported by Cooke is 50 percent larger than -- than those allowed by the manufacturer.

And the mesh size is less than half what is allowed by the manufacturer, which means that the projected area of a single net panel is more than double the -- the projected area or solidity, as we like to call it, of that specified by the manufacturer. That was Cypress Island Site 1.

For Cypress Island Site 2, the --

Q. Go ahead.

A. -- the maximum current conditions were more than three times those allowable by the manufacturer. Again, nominally speaking that would correspond to a drag force on the system of approximately nine times what was -- what was allowed for by the manufacturer.

That problem is exacerbated by the fact

that the net depths are again 50 percent deeper than the -- those allowed by the manufacturer. And the mesh size is less than half that allowed by the manufacturer.

For Cypress Island Site 3, this is a Wavemaster cage, so it is somewhat more robust than the marine systems. It's designed to withstand a current speed of up to 100 centimeters per second or 1 meter per second. However, the extreme current for which -- for that site is 173 centimeters per second, so more than 75 percent higher than that allowed by the manufacturer.

For Hope Island, that was also a Wavemaster system. The manufacturer specifications as provided by Cooke were -- limited the system to currents of 1 meter per second. However, DSA and I both calculated currents that were significantly larger than that.

For Port Angeles Site 1, the -- there are only two infractions or two places where it is out of the range of allowable specifications as per the manufacturer. That is that the significant wave height as calculated by Mott

MacDonald in their analysis is somewhat higher than that allowed by the manufacturer. And the net pens according to -- as reported by Cooke are 20 percent or 50 percent deeper than what that system was designed for.

Q. Okay. Let me -- let me jump in here. I understand how this table works now.

And with respect to this table, are there any sites besides Cypress Island Site 2 where you assess that the mooring systems were not in compliance with manufacturer's recommendations?

A. I didn't compile a table of examples of that in my report. My opinion was based on the fact that each one of these sites in -- in at least one of these -- for at least one of these reasons is -- is at risk of failure. So I don't -- I don't have a table that I can refer to to list which sites had mooring systems that were different from those manufactured by -- specified by the manufacturer or approved by a marine engineer.

Q. Let me -- let me ask the question again.

For any of the other sites did you review manufacturer specifications of mooring systems

as part of forming the opinions in your report?

A. I did review the manufacturer specifications. The manufacturer specifications for the Marine Construction systems that I reviewed, that applies to sites -- Cypress Island Site 1, Cypress Island Site 2, Port Angeles 1, Port Angeles 2.

I can also check my notes about the marine -- the Procean specifications, and -- so I don't have a table in front of me of listing all of the sites that deviated from the manufacturer specifications. But my opinion is based on the conclusion that each one of the sites were outside of the allowable limits in one of these categories.

Q. By one of those categories do you mean wave height or current speed or net measurements?

A. I mean that each one of the sites that -- to be clear, that is not what I mean.

What I mean is that each one of these sites is outside of the allowable specifications for either the mooring system or the configuration, which includes the net pen, or the net configuration, or the

environmental conditions as -- as --
Q. **Okay. So there is three ors there or three different categories. I want to go one by one for each one of them.**
A. Okay.
Q. **Do you have an opinion, besides Site 2, about which of the sites are outside of the manufacturer recommendation for a mooring system?**
A. I don't have a list of -- of which sites violate that.
Q. **Do you have an opinion about whether any of those sites deviate from manufacturers recommendations besides your opinion regarding Site 2?**
A. I want to be careful about representing the opinions that I have in the report, so my opinions are as stated. I -- I do recall that there are other sites that appear to deviate from the manufacturer specifications. For example, the ones that I just listed where the mooring layout is defined in the Marine Construction manual. But, no, I don't have a list of which sites those are, and I am not --
Q. **For the other sites -- for any of the other**

sites did you compare information about mooring layout to what was in the Marine Construction manual?

A. For the sites that did not have a Marine Construction cage?

Q. No. Let me rephrase that.

For the sites that had Marine Construction cages, besides Site 2, as part of forming your opinions, did you look at existing mooring information and compare it to manufacturers recommendations?

A. I don't recall because the opinion that I -- I gave found that each one of the sites is in -- outside of the manufacturers conditions in some manner. So I didn't compile a list of which ones violated the particular requirements of mooring installations being as specified by the manufacturer or as analyzed by a marine engineer.

Q. Let's go back to Table 3. Let's talk about the Wavemaster EX-1, Footnote 35, and go ahead and go to your binder in Tab 35.

First confirm for me, is this where the information came from that is in this table?

A. This seems to be missing the rest of the

manual.

Q. Hold on a second. Let's see, I think we got it in an earlier tab. We do. Tab 11.

Go ahead and remove Tab 11 and give it to the court reporter to label as Exhibit 6.

(Deposition Exhibit No. 6 was marked for identification.)

THE WITNESS: Should I replace the page that I pulled out prior to that? I believe it was Tab 35?

MR. STEDING: You can leave -- you can leave Tab 35 in place. Let's use Tab 11 as Exhibit 6.

THE WITNESS: Okay.

BY MR. STEDING:

Q. Is this manual -- I have in front of me something that is in Spanish that's labelled COOKE CWA 287357 on the first page.

Is this the manual that is the information -- the source of the information that is in Table 3?

A. Yes.

Q. And your footnote actually -- Footnote 35 goes to 287359. I think that is the -- it's labelled page three of that exhibit.

A. Correct.
Q. Do you speak Spanish?
A. No.
Q. Did you have this translated?
A. I used Google Translate to translate the --
Q. Did you use Google Translate on the entire document?
A. I actually went about it a couple of ways. I -- I did a Google translation of the entire document, but then I went back and went paragraph by paragraph.
Q. Did you preserve that Google translation of the entire document?
A. That's a good question. I am looking through my footnotes to see whether I provided that, and I don't see anything immediately as to whether I did.
Q. Where on this page does the information in Table 3 come from?
A. Paragraph three.
Q. And that's las condiciones ambientales para la cual ha sido disenado este modelo es una altura do ola --
(Interruption by the court reporter.)
(Off-the-record colloquy.)

BY MR. STEDING:

Q. In Spanish there is a reference to de 2,30 metros, and the next reference is velocidad, v-e-l-o-c-i-d-a-d de 2,0 nudos.

Do you see that?

A. I see it yes.

Q. Do you know what a nudos is?

MR. CASSIDY: I am going to object to the form of the question.

A. I believe the English translation would be knots. I checked the translation.

BY MR. STEDING:

Q. And how does a knot correlate to a meter per second?

A. Two knots is approximately one meter per second.

Q. And that's how you arrived at 1 meter per second on current speed in Table 3?

A. Correct.

Q. What's the interplay between significant wave height and current speed in terms of manufacturers recommendations? Why are both important?

MR. CASSIDY: Object to the compound question.

A. I'll answer the second question. I think it's the most straightforward, why are both important.

Either excessive currents or excessive waves can cause damage to structures or excessive mooring loads. Going outside of manufacturers recommendations for either one, therefore, puts the system at risk of failure.

THE WITNESS: Can I make a side note? I could use a bathroom run whenever it's convenient, whatever works for everybody else.

MR. STEDING: Sure. Let me -- give me about five minutes here and we'll do that, if that works.

THE WITNESS: Sure.

BY MR. STEDING:

Q. With respect to Table 3, you have not specified for net width all the way down through inspections.

What did you do to try to ascertain the AKVA Group specifications with respect to the items that you have listed as not specified?

A. I went through this manual, which is what Cooke produced in response to the discovery questions, and I went through paragraph by

paragraph using Google Translate looking for any indication of maximum allowable limits for those parameters.

Q. Did you talk to the manufacturer?

A. No.

Q. Did you do any other research to try to come up with the design specifications of these cages?

A. No.

MR. STEDING: Okay. We can take five minutes right now.

(Brief recess taken.)

BY MR. STEDING:

Q. Dr. Dewhurst, back to Table 3, page 19 of your report.

Did you perform any numerical modeling to determine the allowable loads on the structure specified by manufacturers?

A. No.

Q. And you performed no numerical modeling to determine what the actual loads are on Cooke's facilities in Washington state?

A. That is correct.

Q. And these variables that you have in Table 3 are interrelated; is that correct?

A. What do you mean?
Q. Well, you mentioned solidity recently.
What is solidity?
A. Solidity is a parameter that we use to describe something like a net panel, and it's the ratio of actual projected area to the outlying area.
Q. And by area, do you mean the area that is not permeable to water, that water cannot flow through?
A. Right. That would be the actual --
Q. -- total size.
A. That would be the actual --
Q. And that's why -- go ahead.
A. I'm sorry. I'm just trying to -- to finish that answer.
Yes, the area which water cannot flow through is the -- is the actual projected area, whereas the outlying area would be the area you get from looking at the edges of, for example, the net panel.
Q. And so the parameters in Table 3 related to width, length and depth, it is the issue of the total area of the net; is that correct? That's how you would calculate the total area?

A. The width, the length and the depth tell you the outlying area. The --
Q. Okay. What is the outlying area?
A. So when we talk about drag forces on a structure, if we are talking on just a first principles level, the drag is proportional to the area that is projected onto the direction of the flow. So, for example --
Q. Okay.
A. I can expound if you would like.
Q. Go ahead.
A. Okay. So if you have a single cylinder in the ocean, if you have a current speed, acting on that cylinder the drag is roughly proportional to the area that you would see if you were looking in the direction that the water is -- is moving. So the area would be the length of the cylinder times the diameter of the cylinder.
Q. Okay. And how does net twine diameter, mesh size and biofouling influence that drag?
A. So the drag is -- again nominally speaking, the drag on a section of net panel is proportional to the projected area. So the -- the projected area is the number of individual

strands times the length of those strands, times the diameter of those strands, and the number of those strands is inversely proportional to the mesh size. So if you cut your mesh size down by a factor of two, that means you have twice as -- twice as much projected area in that space.

Q. How does biofouling influence that?

A. Biofouling increases the projected area compared to the -- the clean net panel.

Q. And a point of clarification because I'm a lawyer and not an engineer.

What do you mean by nominal load?

A. So reality is always more complicated than the way we are discussing loads here. So as one example of the loads being complicated, drag is proportional to one half times the density of the fluid, in this case seawater, times a drag coefficient, which is usually on the order of one, times the projected area, times the relative velocity squared.

So, for example, when I say the -- the drag force is proportional to velocity squared, that is nominally the first principles answer. In reality, that drag

coefficient can change slightly with flow speed. So it might go up -- the drag might go up more than the velocity squared or sightly less than the velocity squared.

So that is an example of how it's slightly more complicated in reality, but when talking about it, for example, in a conference room setting, it's helpful to talk about the the nominal force or the first principle forces.

Q. And forgive me. I realize I am not on the screen right now because my -- there we go; I am coming back. The camera was misbehaving.

And you talk about risk of failure in a number of places in your report.

What do you mean by risk of failure?

A. As an engineer, I -- my job is to reduce the risk of failure of any -- any system to within acceptable levels. And that's the goal of manufacturer specifications as well, so there -- they specify the conditions under which you can safely operate your system, and the understanding is that if you exceed those conditions then you cross a line to some more appreciable chance of the system breaking,

either partially or catastrophically.
Q. And that's related to load on the system?
A. That is one factor.
Q. What are the other factors?
A. Other factors are the reliability of the materials in the system, for example.
Q. Like if there's defects in metal or something like that?
A. Sure, or excessive corrosion.
Q. So the manufacturer specifications are telling you something about load; is that correct?
A. They're telling you the conditions under which they have deemed it safe to operate these systems.
Q. What is your basis for the conclusion that manufacturer specifications tell you that it's deemed to be safe to operate?
A. That is general engineering practice. The reason we put limits on the systems that we design is because we know that operating outside of those conditions will exceed the -- the loads which we considered when we designed the system. Therefore, the system is at risk of failure.
Q. Did you -- are there other reasons why a

manufacturer might specify conditions?

A. Possibly. Generally in marine engineering wave heights and current speeds are specifically related to the allowable loads on a structure.

Q. And prior to your work in this matter, have you ever worked professionally with manufacturer specifications for these types of systems, net pen finfish aquaculture systems?

A. No.

Q. And did you make any attempt to assess whether or not those specifications were related to load considerations and failure or other operational considerations?

MR. CASSIDY: Object to the form of the compound question.

But go ahead.

A. I didn't -- I did not deem it necessary to look at -- to consider whether they -- or to investigate whether there are other conditions that would -- that would set these limits because in general, in aquaculture engineering, these limits are set by the maximum allowable loads which a system is designed to sustain.

BY MR. STEDING:
Q. What is your basis for the statement, in general aquaculture engineering those limits are for -- are setting maximum loads?
A. That is my professional experience. That is my understanding of numerous standards for aquaculture engineering and for general marine engineering.
Q. But you made no attempt to calculate the specified loads on these systems?
MR. CASSIDY: Object. Asked and answered.
A. That is correct; I did not try to calculate the loads on these systems.
BY MR. STEDING:
Q. I have to ask the question. Have you quantified the risk of failure? Is it a 5 percent? 10 percent? Is it next year? Is it 20 years from now?
A. I have not.
Q. And what would you need to do to quantify the risk of failure?
A. I would need to do a thorough engineering analysis of the system, that would include numerical modeling and that would include

specifying or assessing the -- the environmental conditions for each site.

Q. Which you have not done in this case?

A. I have not quantified the risk of error or the risk -- sorry -- the risk of failure.

Q. What do you mean by risk of failure in the context of your report? Is it a big risk? Is it a small risk?

A. What I mean is that manufacturers set these limits, and the understanding is that if the conditions exceed those limits, then the system is at some appreciable risk of failure. I do not know what that percentage is.

Q. Do you know how long those facilities have been operating without failure?

MR. CASSIDY: Object to the form of the question.

A. Which facilities?

BY MR. STEDING:

Q. Let's go piece by piece.

Do you know how long Cypress Island Site 1 operated without failing?

A. I don't know. I -- as part of this, as part of this work, I reviewed records provided by Cooke to see whether there was any

comprehensive list of repairs and maintenance, and I could not find any comprehensive list.

Scattered throughout the documents provided by Cooke are indications of systems failing partially, whether it's breaking mooring points or dragging anchors, and, of course, some of their systems -- or at least one of their systems failed catastrophically.

Q. So your statements about risk of failure are not quantitative; they are qualitative; is that correct?

A. They -- the -- I have not quantified the risk of failure. What is quantitative is the comparison between the environmental conditions or the net pen configurations allowed for by the manufacturer compared to what was actually measured or reported at the site.

Q. But you have not compared loading allowed by the manufacturer versus loading at the sites either, have you?

MR. CASSIDY: Objection. Asked and answered.

A. I have not computed the loads on any of the systems.

BY MR. STEDING:
Q. Do you have any opinion about whether or not there is a high or a low risk of failure at any of these farms?
A. That's subjective, so, no, I haven't formed -- I haven't tried to categorize risks as high or low.
Q. Okay. Go to first Appendix 7, which is the Cost of Upgrading Net Pen Systems. This is Exhibit 2, page 56. And there is associated with that a figure two, which is an invoice for Wavemaster EX-2 Cage System dated 5/30/2019. It's addressed to Mr. Richard Akers, and it says, Page 2 of 6.
Do you know where pages one or three through six are of this quote?
A. I expect I have them in my records.
Q. Did you review the other pages of this quote?
A. Yes, as I recall.
Q. Do you recall what was on the other pages of this quote?
A. Only vaguely. I believe there were some pictures of the system, for example.
Q. And go to the text on Appendix 7, the Cost of Operating Net Pen Systems. Second -- second

sentence: According to the personal communication with the AKVA Group, their Wavemaster EX-2 cage system is designed to withstand currents up to at least 190 centimeters per second.

Who had that personal communication with the AKVA Group?

A. That was an e-mail conversation between me, Mr. Richard Akers, and a representative from AKVA Group.

Q. Did you recall who that representative was?

A. No, I don't know his name off the top of my head.

Q. When you were personally communicating with the AKVA Group, did you ask for their manufacturer specifications for the EX-2 cage system?

A. I don't recall asking for them specifically or -- yeah, I am going off of memory here, so I don't recall specifically how we phrased our inquiry.

MR. STEDING: And, Kevin, I will represent to you that we have not seen that communication with the AKVA Group, which I think goes into the assumptions of his report,

and we need copies of that, as well as a complete copy of the quote.

MR. CASSIDY: Yeah, to the extent that that hasn't -- that wasn't included in the materials, you know, we can get that to you.

MR. STEDING: Okay. Thank you.

BY MR. STEDING:

Q. When you were personally communicating with the AKVA Group, did you ask them about specifications for EX-1 or the other cage system that is installed by Cooke at Hope Island?

Sorry, that was a bad question.

There's two other AKVA Group cages, Wavemaster EX-1 and the Hope Island, which I think is a 140.

Did you ask them about the specifications for those cages when you communicated with them?

A. No.

Q. And did you ask them -- do you know when the Wavemaster EX-2 system first became available for purchase?

A. No.

Q. Was it available in -- was it available for

purchase in 2012?
A. No, I don't know what -- let me rephrase. I don't know when it would have first became available.
Q. And you did not ask when it was first available?
A. Correct.
Q. And it mentions that it's a 25-meter by 25-meter system.
Are those cages the same sizes, the other cages that are installed by Cooke in Washington state?
A. Some have widths or lengths of 24. Some have widths or lengths of 25.
Q. Do you have any experience with permitting cage replacements?
A. No.
Q. Turn to the next page, to Table 23, which is the Costs to Upgrade Net Pens to More Robust Technology, and above that table there is a phrase or a statement: The 2.7 million that Cooke expended in purchasing and installing new cages at Clam Bay was subtracted from the total cost of acquiring more cages, since those costs would have been displaced by the

cost of the more robust cage.

Where did you get the information that Cooke spent $2.7 million to install cages at Clam Bay?

A. That was a document provided by Cooke, and again I apologize. I see that I -- I missed the footnote on that one, but that was a document provided by Cooke. And I can -- I can go back and --

Q. And so it is your -- it is your opinion, based on the facts that you reviewed, that a 10-cage system was installed in Clam Bay sometime in 2013 or 2014?

A. Correct.

Q. And what kind of system was that?

A. Hold on. Let me note that I -- off the top of my head I don't know if that was a 20-cage system or a 10-cage system. I believe that was an expansion to the Clam Bay site. So I am definitely not certain that that was a 20-cage system.

Q. The bottom of your Table 23 references a more robust 10-cage system at Clam Bay than the one installed in 2013, 2014. I am trying to understand where that information came from.

A. So these -- the way the -- so generally the way that the -- the manufacturers talk about pricing for certain types of cages is by per cage or per square meter -- or sorry -- cubic meter. So to calculate that, the -- what it would have taken to install a more robust 10-cage system, that's approximately -- that uses a per-cage cost estimate. So that would be approximately half the cost --

Q. Sorry, let -- let me clarify my question. I am not asking about the cost.

I am asking about where did you get the information to support the statement that a 10-cage system was installed at Clam Bay sometime in 2013 or 2014?

A. Again, just like the first paragraph on this page, that refers to a Cooke document, a document that was provided by Cooke that includes a table of certain upgrades or capital expenditures.

But I again apologize for having lost the footnote there. I can --

Q. And did you do anything to verify whether or not a 10-cage system was installed at Clam Bay in 2013 or 2014 besides relying on the

document you just went through?
A. No, I only relied on the documents provided by Cooke.
Q. Do you know if it's possible in Washington state to replace a 25 -- 24-by-24-meter cage system with a 25-by-25-meter cage system?
A. I don't know.
Q. And that -- and you have no experience with permitting such facilities in Washington state?
A. Correct.
Q. Does anybody in your firm have experience with permitting such facilities in Washington state?
A. No.
Q. Did you talk to anybody who has experience with permitting such facilities in Washington state?
A. No.
Q. Would you agree that if it's very difficult to replace a cage system with a larger cage system that it may not be technically feasible to do so?
MR. CASSIDY: Object to the form of the question.

A. I don't agree with that statement. I -- I obviously think that any system that is installed needs to be -- have sufficient structural integrity for the conditions in which it's being placed regardless of how easy it is.

BY MR. STEDING:

Q. What do you mean by sufficient structural integrity?

A. It needs to be designed to withstand the conditions at that site.

Q. For how long?

A. That is a good question. Industry practice in -- for finfish aquaculture is to design for the worst case currents that will occur in any 50-year period and combined with the worst case wave conditions that would occur in a 10 period -- a 10-year period and at the same time to also design for the worst case wave conditions that would occur in a 50-year period and the -- combined with the worst case currents that would occur in a 10-year period. That's an example of how we --

Q. What is the source of that industry practice?

A. That's an example of how we -- how we -- how

we quantify those loads.

That particular combination of -- of environmental conditions, I am referring to NS 9415 as an example of how we determined those conditions.

Q. And do you apply NS 9415 to mussel rafts?

A. In general, I use -- I refer to various industry practices. I don't -- I don't generally apply them as a matter of compliance because none of our clients are seeking certification according to NS 9415. Instead I use the principles from that or another relevant standard.

Q. Is NS 9415 routinely applied to mussel rafts, in terms of engineering mussel rafts?

A. As I just described, usually mussel rafts are not -- don't seek official NS 9415 approval, rather we take the -- the principles that are available -- or the principles that are in that standard and use them in our engineering work.

Q. And how long have you been taking the principles that are in that standard and using them in your engineering work with respect to mussel rafts?

A. I have been working on mussel rafts since -- since before my present professional position. I don't recall when I first used -- used NS 9415 specifically. There is a variety of different standards, documents, that we use based on the application.

Q. How long has your firm been applying NS 9415 to mussel raft engineering?

Let me ask that question differently.

Have other members of your firm applied NS 9415 to mussel raft engineering?

A. Not to my knowledge.

Q. Have other members of your firm applied NS 9415 to finfish aquaculture facilities?

A. Not to my knowledge.

Q. And was -- were the standards in NS 9415 applicable in 1999?

MR. CASSIDY: Object to the form of the question.

A. The general principles were certainly applicable. In general, we design not for average conditions, of course, but for extreme conditions, the most -- the worst case environmental conditions that a system is -- is likely to encounter, and there are -- there

are differing ways to quantify those extreme conditions. But when the conditions are -- for example, talking about currents that are 300 percent of those for which the system is designed, then it doesn't -- doesn't really matter which particular standard you apply.

BY MR. STEDING:

Q. Let's go back to Exhibit 4 for a minute, the letter to Mr. Bright from Marine Construction.

You mention that there is a 10- and 50-year sort of peaks that you apply. Are the numbers on wave heights and current velocity a 10- or 50-year? Do you know that?

A. I don't know what definition he used.

Q. But the NS 9415 current number is a 50-year number, is that correct, that you have calculated in your report?

A. I calculated a -- let me make sure. I believe I used the 50-year number, and that was -- and the reason -- yeah, I believe I used the 50-year --

Q. Go to page 20.

A. Yeah. There is a section describing my methodology. I just want to check and make sure that I am getting all of the steps,

representing them accurately.
Q. Go ahead.
A. Yeah. Looking at page 20, at the last paragraph, I calculated the 50-year return period current speeds.
The reason I did that was that Cooke claimed compliance with Best Aquaculture Practices and that Best Aquaculture Practices standards states that currents should be calculated as per NS 9415. So that's what I used as my standard.
Q. And when you say Cooke claimed compliance, do you believe that they are not in compliance with the Best Aquaculture Practices?
A. Correct. The one example --
Q. What's the --
A. -- is --
Q. What's the basis for that belief?
A. Best Aquaculture Practices requires that an analysis of the current speeds at the site must be -- must be conducted as per NS 9415. Based on records that I have reviewed, that current speed -- that analysis was not conducted prior to the work commenced in 2017.
Q. Do you have experience -- I asked this

question earlier, but specific to the Best Aquaculture Practices certification, do you understand how that works?
A. I am familiar with the general concepts. I am not familiar with all of its inner workings.
Q. Did you talk to the Global Aquaculture Alliance about how they certify facilities?
A. No.
Q. Did you talk to anybody who has certified facilities under the Best Aquaculture Practices --
A. No.
Q. -- standard?
Are you aware that the facilities were certified under the Best Aquaculture Practices standard?
A. Yes.
Q. And are you familiar or not with the Best Aquaculture Practices standard to know that that certification requires independent review and audits of the facilities by a third party?
A. Yes.
Q. So is it reasonable to conclude that that third party at some point found them to be in compliance with the Best Aquaculture Practices

standard because they were certified?
MR. CASSIDY: Object to the form of the question.
A. I understand that the -- that a third party did give that certification.
BY MR. STEDING:
Q. But you disagree with that certification -- the validity of that certification?
A. Reviewing the documents provided by Cooke and the standards that were -- that are stated in the Best Aquaculture Practices documents, yes, Cooke's -- Cooke's -- what Cooke did was not sufficient to comply with those standards.
Q. Are you familiar with certifying facilities, the standards, at all? Have you ever done that for any type of standard?
A. No.
Q. Can you explain to me how a third party independent audit concluded that these facilities were in compliance with a voluntary standard but you are concluding otherwise?
MR. CASSIDY: Object to the form. Asked and answered.
A. Yes, I can explain that. One example is --
BY MR. STEDING:

Q. Go ahead.

A. One example is that the Best Aquaculture Practices requires a rigorous current speed analysis as -- as part of ensuring the structural sufficiency of the systems. That analysis, based on my review of Cooke's documents, was not conducted, and I think the fact that they did start conducting that kind of analysis in 2017 is a clear indication that they did not conduct that analysis prior to 2017.

Q. Why do you think that's a clear indication they did not conduct that analysis prior to 2017?

A. You only need to do that analysis once.

Q. Is it your opinion that the NPDES permits require certification --

THE REPORTER: I'm sorry. Could you ask that question again?

MR. STEDING: Apologies.

Q. Is it your opinion that the NPDES permits require certification to the BAP standard?

MR. CASSIDY: Objection. Form of the question and to the extent it asks for a legal conclusion.

A. Bear with me as a turn to the relevant quote.
So the NPDES permits require fish escape plans; they require fish escapement plans. And the plans submitted by Cooke from 2009 to 2017 included the following text: Redundancy and overcapacity shall be utilized in the mooring system.
Based on my review of the --
BY MR. STEDING:
Q. And what's the basis for your --
A. Based on my review of the documents provided by Cooke, the -- the systems are not implementing redundancy or overcapacity. In fact, they are under-designed for the conditions in which they were placed.
Q. Did you, as part of forming that opinion, calculate any of the redundancy and overcapacity? Did you perform any calculations to verify whether or not they are redundant and overcapacity or not?
A. No.
Q. But let me see if I've got this straight.
The basis for your -- so it is your opinion that the BAP standard is required because of that provision in the fish escape

plans?
A. The BAP standard does not specifically require --
(Brief interruption.)
(Off-the-record colloquy.)
THE WITNESS: Let me repeat.
A. The BAP standard is not specifically required by the NPDES permits. Rather to assess whether Cooke was -- was following up with their -- their promise to implement redundancy and overcapacity, I decided that one of the best -- the most rigorous ways to assess that and, well, at the same time being fair to Cooke, was to use the standards that -- that Cooke itself acknowledged as being relevant.
Q. And what do you mean by Cooke acknowledging that those standards are relevant?
A. Cooke claimed compliance with the BAP standards.
Q. What do you mean by Cooke claimed compliance? Do you claim compliance or do you get issued compliance and certifications?
A. I think you do both.
Q. What do you mean you do both?
A. I think that third parties issue certificates

or some kind of documentation saying that they believe a certain farm site is in compliance with -- with the relevant standards based on a number of factors, including based on information supplied by the farm owners, and then I think the farm owners then claim to have complied with that -- with that standard.

Q. But you have never certified such a facility or applied the BAP standards to your clients' facilities, have you?

A. I have never certified the facilities.

Q. Well, what's the basis of this belief?

A. The belief that -- that farms are certified by third parties.

Q. Was this an assumption provided to you by counsel?

A. No. I -- you might have to clarify what assumption you are talking about.

Q. Why did you choose to compare the facilities to the BAP standard?

A. Because I chose to use the BAP standard in particular for this -- for this opinion because Cooke was certified under that standard.

Q. Well, what's your explanation for Cooke being

certified to the BAP standard if you believe they did not meet it?

A. I haven't investigated that process. I -- I understand from the documents that I reviewed from Cooke that Cooke supplied certain documents as evidence of compliance with the BAP standard.

Having reviewed those documents, for example, the -- for Cypress Site 2 in particular, one of the documents that Cooke would have needed to supply would be the mooring analysis conducted by Aqua Knowledge. However, that mooring analysis it turns out was not -- the mooring design analyzed in that document was not the actual mooring system in place at the time of the Cypress Island Site 2 collapse. Also, the currents provided -- the current speeds provided to that engineering group by Cooke appear to not have been based on the rigorous current analysis required by BAP.

Q. Could BAP have just missed this stuff in terms of certifying the facilities?

MR. CASSIDY: Object to the form of the question. It calls --

A. I --
THE WITNESS: Sorry, did I cut you off, Kevin?
MR. CASSIDY: Go ahead.
A. I haven't investigated how that certification process happens.
BY MR. STEDING:
Q. Is that an important part of forming your opinion, to understand how that certification process happened?
A. No, I have enough -- enough information from the documents provided by Cooke to see that they do not meet all of the Best Aquaculture Practices requirements.
Q. Why did you choose the NS 9415 standard? Is that because it's in the BAP standard?
A. Correct.
Q. Does the BAP standard allow for other standards besides NS 9415?
A. I would want to go back and check. It might say to use the NS 9415 or equivalent, and I would -- as an engineer, I would be content using any reputable standard for this practice, for this engineering assessment, but looking at the difference between the current

speeds for which the pens were rated by the manufacturer, for example, the .5 meters per second, and the -- the calculated current speeds of -- of multiple times that value, it's -- no reputable standard will result in an estimate of the maximum expected current speed; that would be less than that allowed for by the manufacturer.

Q. Did the manufacturer apply NS 9415 or an equivalent in specifying the current speed?

A. Which manufacturer?

Q. Well, we can go piece by piece. We can start with Marine Construction.

A. I will have to check. I -- I don't believe that they referenced it specifically, but I would have to review the available documents. But to my knowledge, they did not specifically reference NS 9415.

Q. And I asked that question with respect to the Marine Construction. I see that you are looking at Exhibit 5, the Procean manual.

Was the answer you just gave with respect to Marine Construction?

A. Yes, the answer I gave was with respect to Marine Construction.

Q. The same question with respect to Procean.
Is that a specification that is done consistent with NS 9415 or equivalent?
A. Procean says that their -- their calculations are based on DNV, which is another international standard similar to NS 9415.
Q. Have you worked with the DNV standard?
A. I have used them, yes.
Q. Do you know when it first came into existence?
A. I don't.
Q. Do you know how it's similar to the 9415 standard?
A. I think it would be beyond what I could do efficiently right now to compare and contrast the two.
Q. To be clear, you are looking at section 1.2, Ocean Catamaran System. It's COOKE CWA 26360, is the Bate stamp number. And it says: Based on interim regulations of Det, D-e-t, Norske, N-o-r-s-k-e, Veritas, V-e-r-i-t-a-s, numerous calculations of the systems capabilities have been performed for a large number of different locations.
What -- what is Det Norske Veritas?
A. It's another international standards

organization.
Q. And what were the interim regulations that it's referring to?
A. I don't know specifically.
Q. Did you research that as part of forming your opinions in this case?
A. Not that I recall.
Q. And the manual mentions numerous calculations of the systems capabilities have been performed for a large number of different locations.
Did you contact Procean to get those calculations?
A. No.
Q. Did you perform numerous calculations with respect to the Procean cages?
A. I did not simulate any of the systems.
Q. Do you know when those regulations went from interim to final or are they final?
A. I don't know the history.
Q. And where is this entity located?
A. I believe in Norway.
Q. And does it have regulatory jurisdiction in Washington?
MR. CASSIDY: Object to the form of the

question.
BY MR. STEDING:
Q. Well, let me ask it again.
Are you aware of whether or not that -- those regulations apply in Washington?
A. These aren't regulations. These are international standards.
Q. Oh, apologizes, because they are listed -- they are talked about as interim regulations on Exhibit 5.
A. Sure. No need to apologize for that, but speaking and acknowledging my -- the fact that I am not commenting on the legality, none of these standards are supposed to be law in the U.S., rather they are international standards.
MR. STEDING: And maybe we take about 10, 15 minutes. I think we are getting close, but I need some time to gather some thoughts, put a little food in myself, but let's -- maybe reconvene 3:50 your time?
MR. CASSIDY: Okay.
(Recess taken.)
BY MR. STEDING:
Q. Dr. Dewhurst, just some follow-up questions.
What is the typical useful life of a

mussel raft?
A. It totally depends on the structure of the raft.
Q. Is there a range that -- are these one-year deals? Are these 20-year deals?
A. No. I mean, I wouldn't give -- there is no well documented range.
Q. Do you have any experience with assessing the useful life of a mussel raft?
A. No.
Q. Do you have any experience with assessing the useful life of net pen cage systems, finfish net pen cage systems?
A. No.
Q. What about the terms for mussel raft permits, do you -- are those one-year permits, five-year permits, 10-year permits? Do you have any experience with those types of things?
A. It depends on the state and on the type of permit. Different farms get different permit types, and there is a range of the durations of those permits.
Q. And related to permits, have you ever actually been handed a permit by a client and asked to

interpret the permit conditions?
A. Not that I can think of. Usually the clients have specific questions based on what they were asked by the state agencies or by what the permit says, and my job is to design the system to comply with those requests or requirements.
Q. So you cannot recall having a client actually physically hand you or e-mail you a permit saying please review this permit and give me an opinion on what it means.
A. I guess I can -- I can think of at least one particular instance that was along the lines of what you're describing, but usually it's not -- that is not the format. Usually --
Q. What do you mean by along the lines of what I was describing?
A. The clients shared the -- it was portions of the -- one of the state agency responses, but -- but in general the -- the client distills out their questions for me, and I design according to those questions and requirements.
Q. You would not consider yourself a permit compliance expert or specialist?

A. My expertise is in a specific field, that is the engineering of aquaculture structures to survive the environmental conditions to which they would be subjected to.

Q. Have you ever advised clients on NPDES permit compliance prior to this engagement?

MR. CASSIDY: I am just going to object to the form of the question.

A. Again, often my -- my -- I don't -- I don't distinguish between which requirements come from which permits. The client generally provides which -- the specific questions that they are -- the specific requirements of the permits and I design for those.

BY MR. STEDING:

Q. Going back to Table 3 of your report on page 19.

To confirm, do you know if the current -- you do not know whether the current speeds quoted in this table that you gathered are 50-year or 10-year current speeds?

A. I don't know.

Q. And would a 10- or 50-year current speed change your analysis, if it was one or the other?

A. I did look at the -- the 10-year current speeds when I was analyzing the data. They are, of course, lower than the 50-year current speeds, but they were not -- they were not sufficiently lower to reduce the current speeds to below those specified as allowable by the manufacturer.

Q. Is the Norwegian standard occurring at 5 meters depth? Do I have that correct?

A. Is the standard occurring at 5 meters depth?

Q. The one that you calculated, are those currents at 5 meters deep in Table 4?

A. Yes, I used the 5 meter depth currents.

Q. Did you make any attempts to understand whether or not these currents are specified at a 5-meter depth to be comparable to what you calculated?

A. I do not know from the manufacturer specifications whether those are 5-meter depths or at the surface or deeper. However, the differences that we are talking about would not be accounted for by depth variations, and, in general, using a -- the 5-meter depth is -- those currents that I am calculating are generally lower than the

surface currents.
So if -- so if it is a -- so if I use the surface current, that would result -- that could -- would likely result in an even higher estimate of the -- of the currents to which these net pen systems are subjected.

Q. How much variability is there between a surface current and a current at 5-meters?

A. It depends on the site.

Q. Did you assess the variability between the surface current and the 5-meter depth for these sites?

A. I didn't formally assess it. I looked at -- I did look at the data for the full range of depths. Though when I --

Q. Sorry, you broke up there on video.
So did you say you did not look at the data for all the depths?

A. I did look at the current measurements for all the depths. I -- for the formal analysis I used the -- the 5-meter depth because that is consistent with the NS 9415 practice, which is required by the BAP standards, which are the standards that Cooke chose, and I considered that to be the most representative and fair to

Cooke.
Q. I appreciate you being fair to Cooke.
And you believe that those current measurements are comparable to the manufacturer standards?
MR. CASSIDY: Object to the form of the question.
A. I -- I believe for the -- for the differences that we are talking about, for example, the difference between the .5 meters per second allowed for by the manufacturer and, say, the 1.53 meters per second present at Cypress Island, that difference would not be accounted for by variations in -- in depth.
BY MR. STEDING:
Q. What is the basis for that belief?
A. Personal experience processing current measurements, including -- including --
Q. Could the variation be based on differences --
(Poor audio.)
(Off-the-record colloquy.)
THE REPORTER: Variation be based on differences?
BY MR. STEDING:
Q. Between the 10- and 50-year current.

A. No, the difference between a 10- and a 50-year current would not account for differences of that magnitude.

Q. Would a combination of, say, depth in 10- and 50-year current account for differences, those differences?

A. It's highly unlikely.

Q. Have you performed that calculation?

A. Well, using the surface current data would likely result in a higher estimated maximum current speed, and I did look at the current speeds, the maximum expected current speeds, as a function of -- I did look at the maximum expected current speeds as a function of return period, and -- and generally speaking even the 10-year currents are well outside of the manufacturers specifications.

For a bit of background, the relationship between return period and the maximum expected extreme value, for example, the current value in that return period, is not in the relationship at all. So as -- as you increase the current speeds beyond say -- or the return period beyond a few years, for example, you quickly approach the -- say, the -- the

50-year return period current speed.
As another point that I think is relevant, is that no -- no aquaculture engineer that I can think of would rationally design a system that is designed to survive for 20 years for only a 10-year return period. That would effectively mean that your system is more likely than not to fail before -- before the end of its life.
BY MR. STEDING:
Q. Can you say solely based on currents that -- that if you design it to a 10-year return period but you want a 20-year lifespan, that it will fail if you exceed that 10-year return period over that lifespan?
A. Exceeding the manufacturers specifications does not necessarily mean that it will fail. It means that the risk of failure is appreciable.
Q. What do you mean by appreciable?
A. That definition is up to the manufacturer. It depends on what risk they thought was acceptable when they set those requirements.
Q. And did you ask the manufacturers what risk they thought was acceptable when they set the

requirements that are on Table 3?
A. No, I did not.
Q. Did you attempt to ask that?
A. No, I did not attempt to ask them.
Q. Did you ask anybody in your firm if they were -- if they were aware of what risk was acceptable when setting current limits on finfish aquaculture facilities as manufacturer specifications?
A. I am familiar with the typical industry practice for settings these standards. I did not --
Q. You are familiar with it --
A. I did not ask --
Q. Are you familiar with the typical industry practice for salmon net pen facilities?
A. Yes, we use the same -- the same practices across many fields of aquaculture engineering.
Q. Earlier you testified that you did not -- you did not interview or talk to marine engineers that had cited or installed finfish aquaculture facilities.
What's your basis for your assertion that the same practices are used across all fields in marine engineering?

MR. CASSIDY: Object to the form of the question.

Go ahead.

A. We refer to the same standards in general and that's the purpose of these standards, like the BAP and NS 9415, is to standardize the approach to quantifying the structural reliability of systems. And since finfish aquaculture is the furthest along in developing standards, we often borrow the principles from the finfish aquaculture systems when -- when designing other aquaculture systems.

MR. CASSIDY: So we have the -- I'm sorry, Doug.

MR. STEDING: Yeah, I saw that.

MR. CASSIDY: I just wanted to let you know.

MR. STEDING: Let's mark that as -- and I've lost track of exhibits, that time of day -- Exhibit 7, I think?

MR. CASSIDY: And we'll mark it as Exhibit 7. Just because it came through the printout, I just want to confirm with you the Bates numbers. It starts -- it starts at

13557 and goes to 13572.

MR. STEDING: That was -- yeah, that is right.

(Deposition Exhibit No. 7 was marked for identification.)

BY MR. STEDING:

Q. For the benefit of this document, I would like to go back to your report, Exhibit 3.

You have been handed what counsel for WFC has described with Bates stamp numbers, and it says SystemFarm W24-3,16.

And is that in front of you?

A. Yes, it is.

Q. And is this the Marine Construction manual that you reviewed?

A. Yes, it is.

Q. And you are going to have to help me here because I just got this document.

Where in this manual are the specifications set forth in your Table 3 in your report?

A. I recall that the specifications largely come from the letter that the -- Marine Construction provided to Cooke Aquaculture when asked what the maximum allowable

environmental conditions were for their cages.
Q. So this -- this steel cage system, which on the front is dated 16 June 1999, does it contain current speed, significant wave height specifications?
A. I don't recall whether it repeats those. I don't believe that it does.
Q. Go ahead and take your time and review it.
A. (Witness complying). No, I don't believe this document contains the specifications which I referred to or which were provided by Marine Construction in their letter.
Q. So is it possible, based on this documentation, that Cooke did not -- or Cooke's predecessor that installed these cages did not receive specifications for current speed or significant wave height when it installed the Marine Construction SystemFarm W24-3,16 cage systems?
MR. CASSIDY: Object to the form.
A. I -- I don't know what -- when Cooke received various documents, except those that have dates on them. Certainly -- certainly claiming to be implementing redundancy and overcapacity in a system without having --

without knowing what that system is designed to withstand would be unwise, I would tell my clients.

BY MR. STEDING:

Q. Do you agree that this document has a date on the first page of 16 June 1999?

A. I do.

Q. And there are no wave height, current speed, net width, net length, net depth, net twine diameter, mesh size, biofouling, or mooring tension specifications in this document.

MR. CASSIDY: Object to the form of the question.

A. Yeah, that is incorrect. It does specify cage sizes on page 5 of 16.

BY MR. STEDING:

Q. Does it specify cage sizes or just tell us what size the cages are?

A. Would you like to elaborate on the distinction?

Q. Well, a specification to me is -- is something where you are saying you need this to be this size. Here the cage size is just -- it's 24-by-24 meters. It's not saying anything about what it should be.

A. So this describes the system as provided by the manufacturer.
Q. Okay.
A. In general if -- if a customer deviates from -- from the system, from the specifications provided by the manufacturer, then -- then the manufacturer's guidance can no longer be assumed to apply and they would need to do a new engineering analysis of the complete system to make sure that it can withstand the -- the loads on the -- the modified system.
Q. But there are -- for this document there is no current speed to deviate from; there's no specified current speed; is that correct?
A. Correct, that does not come from this document.
Q. And in this document there's no significant -- specified significant wave height; is that correct?
A. That is correct.
Q. And there is no specified net depth; is that correct?
A. That is correct, to my knowledge. I haven't reviewed it thoroughly to see whether the net

depth is specified.
Q. Go on and take your time.
A. Okay. (Witness complying.) I don't believe that this document specifies the net depth.
MR. STEDING: Okay. Let's take five minutes and then I probably have about ten minutes.
(Brief recess taken.)
BY MR. STEDING:
Q. Just to clarify in terms of the -- assessing the load on a facility, load, in very general terms, is a function of force and solidity which results in a load.
Do I have that correct?
A. No, that's -- not to be -- recognizing that you are not an engineer, I don't think that's a particularly good representation.
Can I -- well, I guess, ask some clarifying questions and I can try to help us get that straight.
Q. What I am looking for is we have talked a lot today about understanding the load on a facility and the variables involved in understanding load. And we have currents and waves and wind, which I think of as force,

that -- that then interacts with the facility, and at least underwater that's a function of solidity in a large part. There's other factors influencing.

Do I have that correct?

MR. CASSIDY: Object to the form.

A. One of the forces -- one of the major forces on aquaculture structures is drag, and drag is, on any particular component of a farm, is proportional to a number of things, including the -- nominally the projected area of that particular component.

For a structure like a net, solidity is one way that we can characterize that projected area.

Q. And do the nets behave as, you know, bags that are sticking down in the current the whole entire time? What happens to them when drag is applied to them? Do I have that right? Am I getting that right?

A. Yes, very good.

When -- when you apply any force to any structure it moves to some -- to some degree. Stiffer structures move less. More flexible structures move more.

For nets, which are -- which are held at the top by -- by, say, the steel structure of a net pen system, the net -- and I'll try not to talk with my hand for the sake of the reporter -- the net will deform. In general that means it's -- it's bottom end will move horizontally. And if there were -- if the net were not weighted down, then it could -- then it would deform a lot, and that reduces the volume which the fish have to live in and that's -- that's not good news for the fish farmers.

So what fish farmers do is they apply significant weighting around the bottom of the net to try to keep the net as rigid as possible.

Q. Did you assess the amount of weighting that is applied to these facilities to keep the nets as rigid as possible?

A. No.

Q. And if those nets deform, does that -- you mentioned it's not good for the fish.

Are you aware of what happens to a fish when nets deform?

A. I am not a biologist, so, no, I won't go -- I

won't elaborate further than that, but generally -- generally farmers try to minimize the -- the reduction in volume for any given net setup, and it's -- yeah.

Q. Is that because -- is that because if you reduce the volume the fish can die?

A. Again, since I'm not a biologist, I won't try to speak to the effects on fish.

Q. Are you aware of the value of the fish that are in net pens?

A. I know they are valuable. I don't usually quantify their market value.

Q. Is the fact that they are valuable a pretty strong incentive to keep escapes from happening?

MR. CASSIDY: Object to the form.

A. Yes. Farmers do not want escapes to happen and they want to prevent escapes. They want to reduce the risk of escape but as much as they can while -- while, generally speaking, spending as little money as they can. And that cost benefit analysis is -- is part of the engineers -- sorry. And that's the -- that is the balance that always puts some constraints on our engineering analysis.

BY MR. STEDING:
Q. Have you ever performed such a cost benefit analysis for clients?
A. I don't usually do the the cost benefit analysis. What I provide is the cost of the structure, if the client asks me to do that part. I provide the cost of structure, and they generally plug that into their own economic models.
Q. I think we're winding up.
Have you been provided a copy of the report by Dean Steinke in this matter that was dated July 5th 2019?
A. I have been provided with a copy of Mr. Steinke's report, yes.
Q. And have you reviewed that report?
A. Yes.
Q. And do you have opinions about that report?
A. I have not written out formal opinions on the report.
Q. Have you formed opinions about that report?
A. Yeah, I can speak generally as to the -- as to the -- how it -- how it alines with my report.
Q. Do you agree or disagree with his conclusions?
A. Mr. Steinke made several -- several comments,

some of which I agree with, some of which I disagree with, but in general very little or possibly even none of his claims contradicted mine in any significant way.

Q. Do you disagree with Mr. Steinke's expertise to speak to the -- the practices associated with siting net pen facilities of the type at issue in this litigation?

MR. CASSIDY: Object to the form of the question.

A. Mr. Steinke is an engineer with a good reputation, and I respect him and his firm.

BY MR. STEDING:

Q. Has he done a lot more work on net pen aquaculture engineering -- net pen finfish aquaculture engineering than your firm has?

A. Yes.

MR. STEDING: Okay. I'm done.

Kevin, do you have anything?

MR. CASSIDY: No, I don't have anything, Doug.

MR. STEDING: Okay. We'll order an E-transcript and we'll remind everyone that -- that Kevin reserves signature.

MR. CASSIDY: Thank you.

MR. STEDING: Have I got that right?

MR. CASSIDY: That is correct.

MR. STEDING: Okay. Thank you, Dr. Dewhurst. We appreciate your time.

MR. CASSIDY: Do you want to ask him -- okay, so we'll go off the record.

We are done, Doug?

Okay. We'll go off the record.

(The deposition concluded at 4:40 p.m.)

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DEPONENT SIGNATURE PAGE

CAPTION: WILD FISH CONSERVANCY V. COOKE AQUACULTURE PACIFIC, LLC

DEPONENT: TOBIAS DEWHURST, PH.D.

I, TOBIAS DEWHURST, Ph.D., acknowledge that I have read Pages 1 through 167 inclusive of the transcript of my deposition taken on July 18, 2019. I further acknowledge that:

(check appropriate language)

______ the same is a true, correct, and complete transcription of the answers given by me to the questions recorded therein.

OR

______ except for the changes noted on the attached errata sheet, the same is a true, correct, and complete transcription of the answers given by me to the questions recorded therein.

____

TOBIAS DEWHURST, PH.D.

Subscribed and sworn to before me

this_____ day of__________, 2019

____

Notary Public

CERTIFICATE

I, Beth Gaige, a Registered Professional Reporter and Notary Public in and for the State of Maine, hereby certify that the within-named deponent was sworn to testify the truth, the whole truth, and nothing but the truth in the aforementioned cause of action.

I further certify that this deposition was stenographically reported by me and later reduced to print through computer-aided transcription, and the foregoing is a full and true record of the testimony given by the deponent.

I further certify that I am a disinterested person in the event or outcome of the above-named cause of action.

IN WITNESS WHEREOF, I subscribe my hand and affix my seal this 4th day of August 2019.

Beth Gaige, RPR
Notary Public

My commission expires:
August 22, 2019

THE ORIGINAL DEPOSITION OF TOBIAS DEWHURST, Ph.D., SHOULD INCLUDE THE FOLLOWING CORRECTIONS:

____

TOBIAS DEWHURST, PH.D.